2 Biology and Culture – an Overview of the Field

> "Biology, as a science, cannot exist outside culture; culture, as a practice, cannot exist outside biology." *(Davis and Morris 418)*

Biology and culture, science and humanities – disciplines that traditionally have been thought to have nothing to say to each other, that are believed to have widely different epistemological approaches, have in the last three decades been brought into dialogue to tackle some of the more fundamental questions of today. The contested issues of the 21st century never only concern nature or culture, they are always both natural and cultural, social, political. We can no longer think of them as separate entities: Biology, as Davis and Morris argue in the introductory quote from 2007, even as "pure" science is always cultural, and culture depends on biology. Social concepts and assumptions drive biology, culture cannot take place outside of the lived, material reality of everyday life (418). This becomes nowhere more apparent than in the many issues surrounding biotechnology. The recent headlines about scientists being able to "delete" or rather cut out genetic defects using CRISPR technology, "genetic scissors," in embryos during in-vitro fertilization are a prominent example, such as the highly contested germ-line engineering performed by a Chinese scientist in 2018 (Kolata et al.).[1] The ensuing questions of treatments versus enhancements, justified and unjustified use, access and affordability, social justice, civil rights and discrimination, value judgements and normalization already point to the multiple convergences of biotechnology – as applied science – and

1 Dr. He Jianku used CRISPR/Cas-9 technology to alter the genome of twins to be resistant to HIV by deleting a gene sequence responsible for creating a protein that the H.I. virus needs to enter cells. His experiments have received wide-spread critical backlash in the scientific community and society around the globe because they mark the first publicly known attempt at modifying the human germ line. Subsequently, his research activities were suspended, the Chinese government as well as his university investigated his work (leading to the termination of his contract with the university) and he may face more consequences. In March 2019 it was reported that the mutations He Jianku provoked may (inadvertently) have had an effect on the babies' cognitive abilities – raising the possibility of cognitive enhancements (Regalado, "China's CRISPR"). All in all, the controversy around He Jianku's experiments is also part of an on-going race in biotechnology between China and the USA in particular, with China often described as enabling more controversial research to win this race.

culture. Investigating biology from a cultural standpoint, then, can shine light on both the effects and the epistemic assumptions behind biotechnology's current appeal.

As Davis and Morris claim: The "specter of biocultures is upon us." They had a "new (but perhaps in a while old) and counterintuitive (but perhaps destined to be commonplace) proposal: that culture and history must be rethought with an understanding of their inextricable, if highly variable, relation to biology" (411). In the past decade since this statement has been formulated, doing "biocultures" has become more and more common but not yet commonplace. Davis and Morris' assumption, however, remains true more than ever. To fully grasp the scale and future effects of biotechnologies' sway over contemporary daily life, science needs to be thought of also from a historical and cultural perspective, and literature and culture need to be engaged from a scientific one (411). Likewise, Victoria Pitts-Taylor, in 2016, argues that transformations in the sciences have promoted the naturalization of other fields of knowledge: the dualism between social and biological – as well as the respective disciplines – is "being supplanted by the more monist notion of the 'biocultural'" (1). The omnipresence and amalgamation of biology and culture expressed in the term biocultural in contemporary life makes it necessary to not only address one or the other but both (Pitts-Taylor, "Mattering" 1). They need to enter into an even more sustained dialogue, one that is mutually beneficial by strengthening science and deepening cultural analysis. This is even more true in 2021, Shiloh Krupar and Nadine Ehlers claim: "*the time for biocultural analysis is now*" (14, italics in original). Following Davis and Morris' approach, for them "the body and culture are never separate" and "biomedical and cultural arenas are enmeshed" (9).[2] They argue that biocultural studies are a tool to understand how biomedicine today extends far beyond its original sphere of the clinic, lab and hospital into social practices, biosecurity concerns and biopolitical governance.[3] Key to the study of biocultures, for them, is not only a biopolitical focus but also a certain methodology that is "intertextual, collaborative, [and] multiply-scaled." "Intertextual reading[s] between various kinds of cultural products, knowledges, policies, and practices" are combined with cross-disciplinary blends of methodologies and approaches – bridging different "regimes of knowledge" (Krupar and Ehlers 7-9).

2 The human body is also at the center of Samantha Frost's use of the term "biocultural" in 2016. Frost rethinks humans as "biocultural creatures," as made in and through convergences of the biological and cultural in the human body itself. Humans are not self-contained entities but interact with "substances, creatures, and organisms" (Frost 148), even on the molecular and atomic level. Human bodies, human materiality, are cultured within their material, social and symbolic world.

3 In light of the Covid-19 pandemic and its biopolitical effects, Krupar and Ehlers' reading is very much focused on the level of biopolitical governance and biopolitics. They look at "health issue terrains" as the arena and sphere of biocultures, in that here "biomedical logics extend beyond the confines of medicine to govern populations and discipline individuals" (5). They advocate for biocultural analyses that move from micro scales of individual bodies to macro levels of institutions and population-level governance – "from the institutional to the individual to the molecular" (10) – but they also consider how "life-making practices" can create deadly conditions and "perpetuate inequitable distributions of life" (11-12). Especially the later chapters (11 and 12) of this book look at different levels of biopolitical governance as well as the negative side effects – discrimination, unequal access, vulnerability – that come with DIY biology as a biocultural practice.

As a *methodology* biocultural studies, as Krupar and Ehlers argue, can thus integrate insights from many different disciplines and theories. Fittingly, sources and inspiration for this book come from a variety of backgrounds: These reach from classical considerations of social constructionism in Science and Technology Studies (STS), theories of medicalization, knowledge production and dissemination – the cultural basis of science – towards body studies and the renewed focus on the material reality and basis of life (including theories on biological and cultural plasticity and affect) as well as concepts taken from theories of governmentality and (bio-)power. While it would go beyond the scope of this book to go into detail in all these fields, I would nevertheless like to acknowledge how some of them have shaped my understanding of the questions at hand: Science and Technology Studies, for example, has influenced my discussions with its focus on network-oriented thinking and the role of researchers and research settings in the production of knowledge; medical sociology has brought to the table considerations of power relations in the medical encounter and the importance of socio-cultural contexts for the construction of knowledge and the experience of disease (cf. Lupton, *Medicine*); from the medical humanities I have taken my focus on literature, textual study, signification, discourse analysis, narrative structures and the construction of meaning, while medical ethics, though subconsciously, resonates in questions of discrimination, access and distributive justice.

Cultural Studies proceed from a sense that no aspect of human life can be separated from the questions and effects of culture, that also other disciplines need to be partially understood through culture. This inherent interdisciplinarity – bringing together diverse disciplines, organizations of knowledge and "bodies of expertise" – offers unique possibilities for the study of biology, medicine and biotechnology because at the same time that Cultural Studies questions the cultural construction of reality it also beliefs in and acknowledges the importance of material realities (Grossberg 15). This preparatory chapter provides a (literature) overview of the directions that humanities inquiry into topics broadly understood as 'biological,' 'corporeal' and 'medical' has taken as well as an introduction to the most important concepts needed for my analysis. I emphasize these conceptual issues and methodological approaches, however, without claiming comprehensiveness or completeness. Rather, my aim is to provide a set of tools that have been developed in the study of 'bio-cultures' and which were useful for my research, to embed my analysis in existing biocultural discourses and scholarship.

2.1 Constructing Biology

A life without biotechnologies seems unimaginable today. Society is permeated with scientific findings and their practical applications: Genetically modified foods, genetic testing, pharmaceutical drugs, responses to global pandemics are just some of the more prominent examples. But more than that, we all "consume representations of science and incorporate them into our everyday understandings" of the world through the media, culture and education but also through scientific and medical interventions into the body (Erickson 3). Science, and by affiliation biology, we will see, is not disparate from culture, but instead incorporated into a continuous cycle of mutual influences.

The values we assign to biotechnologies, the judgements we make about their use, the way we consume them, how, when and where we expect and allow biotechnologies to shape our lives, depends on culture. How is biological knowledge produced? How do we grasp concepts, ideas, materials that are both so intimate and abstract, highly present but invisible? How are they communicated to a broader public? What roles do language and culture play in this process? These are some of the questions addressed in this subchapter.

I here follow the position that in order to truly evaluate biological knowledge, concepts and biotechnological applications, we need to study them both as objects and as embedded and produced in a larger system of knowledge production – one that is inherently social, cultural and historical. This discussion is indebted to postmodern, social-constructivist thought and its highly influential and transformative ideas. Postmodern theories have challenged the perceived objectivity, superiority of science and the scientific method in favor of a focus on the constructed nature of scientific knowledge. Fittingly, this subchapter looks at questions of knowledge production, the role of language, narrative and discourse and the ways in which biology and biotechnology are 'culturalized' in this regard. DIY biology and medicine, in part, try to renew how and where knowledge is produced, who is involved in this production and on which terms. They want to open up a system that has been regarded as closed-off and elite for decades. For this process, it is crucial to acknowledge the cultural, social, historical influences on biological knowledge production. But the influences of culture – of narratives, discourses, the imagination – do not only shape how knowledge is produced but also how it is translated for the public and in a last step, how it affects (human) bodies.

Knowledge Production

In light of the dominance of science in contemporary life, it is no surprise that scholars have taken on the challenge to de-mystify the production of scientific knowledge, to shine a light on how the social and cultural context impact science, to question how tools, knowledges and technologies are conceptualized and brought to fruition. Science and Technology Studies (STS) have taken on this challenge. The social constructivism of the 1960s and 70s saw scientists as *constructing* not discovering knowledge, challenged the objectivity and formality of scientific practice and methods, and turned toward the places where science is "made/practiced" (such as the lab) (Erickson 86).[4] According to Mark Erickson, "science and technology are social activities that reflect the social conditions of their production and the social conditions of those involved in their production"

4 In the 1980s and 90s, another highly influential theory was developed in STS: Actor-network theory (ANT) focuses on the multifold and entangled relationship between human and non-human actors in given (social) formations (Erickson 90). In ANT, non-human actors (ideas, technological artefacts, other relevant objects) are seen as contributing equally to social situations. While I do not use ANT, its focus on relationships and the ability of non-human actors to participate in networks and systems might also be an interesting entry point to DIY biology, especially when considering its technological basis.

(1). The knowledge emerging from such scientific situations is constructed and contingent on its respective context, such as the interactions of scientists, prevalent world views, available resources. While most humanities disciplines acknowledge the high impact of social and cultural contexts on scientific knowledge production, in scientific institutions, Erickson laments, this view is not all that prevalent: rather, science is seen as a "progressive, neutral activity" producing "true knowledge and facts about the natural world" by using standard methods (2). The common understanding is that science produces more "concrete, 'better' and more factual" results (2); science is not just seen as a separate but as a superior road to new insights. This view has also made its way out of the laboratory: Society is filled with such representations of science, so that a deep-seated belief in science is persistent, shaping the understanding, expectation and in conclusion the practice of science (Erickson 2).

Science, thus, has become a dominant way of thinking, a dominant rational for how we shape our lives, as Erickson demonstrates in his thorough account of the interplay between science, culture and society. Formal science is perceived as a special way of discovering "facts," characterized by hypotheses, experiments, and the validation of hypotheses or theories based on empirical methods with their impressions of objectivity, rationality, unambiguity (Erickson 31-32). In the public's view, science is straightforward, a "progressive march towards objective truth," giving definite answers and producing "facts;" that hypotheses and theories can prove false or be revoked based on new data is often overlooked (Boyd 12). Still, this "scientific method" has given birth to one of the most prevalent, but latently overlooked -isms of our time: *scientism*. This standard account of science as having a higher status than other forms of knowledge production is deeply ingrained in our society (Erickson 71-75). This scientism explains why we tend to privilege scientific explanations and look to science and technology to provide solutions for many of the contemporary troubles (Erickson 23-25). That this thought style is not just prevalent in the scientific community, but in society as a whole, shapes how science and technology are perceived and evaluated in the public sphere. The cultural context becomes particularly relevant here: We have a society that on the one hand deeply, almost blindly, believes in science and on the other hand is (strictly) divided into experts and lay persons, those initiated and those outside.

However, scientism also needs to be taken with a grain of salt: Especially in the US, we can witness a declining belief in scientific findings and facts in parts of the US population. This declining trust in science is part of an overall rift in American society that has led to increasing polarization of the social and political discourse; it is part of the rhetoric of 'fake news' and conspiracy theories that have gained precedence during President Trump's four years in office. Krause et al. argue that confidence in the scientific community has been rather high – with 40 percent of Americans expressing a great deal of confidence – and rather consistent over the past decades. However, they also admit that some subgroups of the population express more confidence in science than others. According to Plohl and Musil, key variables that influence trust in science are political conservatism, religiousness/religious orthodoxy, conspiracy thinking and to some extent the level of education. So, while studies do show that overall trust in science and the scientific community is rather high and stable (with nuances), public perception of those who do not express trust in science has shifted: With the rise and popularization

of conspiracy theories and 'alternative facts' by some of the highest-ranking officials in the government, mistrust becomes more visible and fact-checking the norm. The debate around and increasing urgency of climate change as well as the Covid-19 pandemic are two highly visible issues around which this shift in public perception and poisoning of the political discourse has revolved.[5]

A helpful tool in the context of scientism and knowledge production is the concept of "thought communities" – groups of people that share similar epistemological standpoints. Erickson, taking up Ludwik Flecks idea of a "thought community," defines these as groups of individuals that share a particular way of thinking, using the same ideas, concepts and theories. This "way of thinking", or thought style, is embodied in the discourse of the community.[6] These esoteric – "inside" – and exoteric – wider, social – communities influence each other so that both are involved in producing scientific knowledge: The exoteric community through representation and discussion (in culture), the esoteric through research and experimentation in the lab, though influenced by cultural discourses and conceptualizations (19-23). Erickson, therefore, argues that we need to construct science and scientific knowledge production as a "two-way street between the esoteric communities of which formal scientists are members and the exoteric, public communities to which we all belong" (3). This concept makes it possible to see how what is often valued as neutral, objective, and independent is in reality shaped by processes and discourses outside of scientific practice (Erickson 19-23). These concepts also, and this will become crucial, point to the fact that science in itself is always a collective project: While individual achievements and 'genius' might be dominant scientific master narratives, the interactions between different thought communities, the entanglements with cultural assumptions, the dialogue between different stakeholders allows us to indeed see scientific knowledge as created in community.

But "thought communities" also play a role when knowledge has to travel between different groups of people. In order to bring specialized knowledge from the scientific community into the public, conscious processes of translation are needed: The concepts, terms, discourses of one thought community need to be translated into a language that is more familiar to the lay public: "In this process there is an inevitable change in meaning – we are moving from one thought community, one language-game, to

5 According to Boyd it is not just political factors that underly skepticism of COVID vaccines, but also a breakdown of the distinction between expert and non-expert as well as misconceptions about the "nature of the scientific process."

6 Ludwik Fleck developed the idea of "thought styles" and "thought communities" or collectives in his book *Entstehung und Entwicklung einer wissenschaftlichen Tatsache; Einführung in die Lehre vom Denkstil und Denkkollektiv* (1935), in which he identifies the social nature of scientific knowledge production. We all are members of various thought communities (not just scientific ones) and cannot abandon all of them, since each of these has its own way of making sense of and describing the world. Scientists, for example, might in their work life be part of a scientific thought community that shares a particular, rationalistic concept of life or biology, but in their private life they might identify with another thought community that emphasizes subjective experiences over rigid dogmatism. On a side note: These "thought communities" could also be a valuable short-hand to understand how mistrust in science and the 'establishment' interact with 'filter bubbles' in social media and conspiracy thinking.

another" (Erickson 33; 70).[7] Changes in the "language-game" bring with them new linguistic concepts, different connotations, abstractions and simplifications. Knowledge gained in one community will have to be adapted to the experiences and insights of the wider community, using language that is familiar, relatable, trusted.[8] These processes of translation affect the interactions with knowledge and its production in both directions: On the one hand, in the scientific community simplified, adapted concepts might shape how (further) knowledge is produced. Ludwig Wittgenstein's ideas about language – more specifically his investigation into how the use of the term "natural law" shapes the research that is being conducted – come in handy here: They tell us that how we talk about science changes the way we perceive it (Wittgenstein and Klagge 430). The language we use is not a "perfect tool for describing and explaining the world", but "something that actually hides things from us, confuses us, leads us astray" (Erickson 17-18). The simple act of using specific words, concepts and frameworks shapes how scientists carry out their investigations. It makes them look for certain things, shapes their thinking in certain ways and thus determines the results they receive.

On the other hand, the translation of scientific knowledge often has the goal of increasing the *scientific literacy* of the wider community. Most commonly, being 'literate' is used for people who are able to read and write, and thus denotes some form of competence in a specific area, some form of proficiency or expertise. But with the increasing dominance of science and biology in social and political contexts, the concept has since the 1980s and 1990s also been used in the context of high school and college science or biology education: Educators had realized the importance of students being "scientifically literate" in order to fully grasp scientific developments and take part in social discussions. Gordon E. Uno and Rodger W. Bybee, for example, in 1994, developed a concept of biological literacy that rather than seeing it as an end point – to either be achieved or not – defines biological literacy as a continuum on which individuals are positioned (553). This continuum for Uno and Bybee ranges from nominal, to functional, to structural to multidimensional – from a naïve understanding in words only to a complex understanding of biology as a discipline and its interactions with society (554-56).[9] For them it is essential that students learn to think creatively about biological concepts,

7 The form that this translation takes depends on the medium: specialized newspaper articles will use a different language – and require a different translation – than audio-visual use in popular culture, films and TV. The form that scientific knowledge takes in the public sphere can thus differ widely, depending on the intended audience.

8 More specifically, such processes of translation are often also needed in the scientific community itself. With various fields of specialization, findings from one field are not necessarily understandable for another, even in the same general discipline.

9 In more detail, Uno and Bybee write: "A biologically literate individual should understand biological principles and major concepts in biology, the impact of humans on the biosphere, the processes of scientific inquiry, and the historical development of biological concepts. He or she should develop personal values regarding scientific investigations, biodiversity and cultural diversity, the impact of biology and biotechnology on society, and the importance of biology to the individual. And he or she should be able to think creatively, formulate questions about nature, reason logically and critically, evaluate information, use biological technologies appropriately, make personal and ethical decisions related to biological issues and apply biological knowledge to solve problems." (Uno and Bybee 553). What is interesting is their focus also on the interaction between biology

critically examine knowledge claims and gain a good understanding of basic scientific principles (553). Uno and Bybee argue that true biological literacy requires more than school or college learning and extents over the whole life and lifespan of students; it is a skill that should be honed and fostered in schools and colleges in order to instill in students a keen interest in biology that they can pursue also after leaving the education system (557). This approach, I think, is particularly relevant as it allows people to gain literacy in a much more sustained way needed for a field that changes as fast as biology. At the same time, it means that in order to be biologically literate, in this definition, a certain consistency in engagement with biological concepts is needed. The 'education' or rather critical examination cannot end after formal education has ended. To be scientifically literate, thus, is not so much concerned with content as with methods, processes and approaches and thus encompasses knowledge, understanding as well as evaluation. A scientifically literate individual should understand how scientists 'do' science and what scientific concepts and basic scientific principles mean, but they should also be able to put results into perspective and make informed evaluations, personal and ethical, about applications of biotechnology.[10] It is here that discussions of scientific literacy have often drifted towards questions of citizenship and social participation. A society so dominated by science needs more "bodies who know" (Steinberg 29), it has been argued, especially because the stakes are rising with more and more sophisticated and invasive technologies. For further references, I use biological and scientific literacy almost interchangeably, regarding biological literacy, following Uno and Bybee, as a subset of scientific literacy. Both have as their goal a more differentiated competence to investigate and evaluate scientific knowledge claims more generally.

From a Cultural Studies perspective, the media of a culture can certainly be used to facilitate some of this scientific literacy in the broader population, thus reducing the imbalance of power and creating a more egalitarian approach to knowledge production. Popular culture might be especially impactful here due to its ubiquity in everyday life. In his examination of the public perception of science and scientists in popular culture, A. Bowdoin van Riper argues that because popular culture is "more pervasive, more eye-catching, and (with rare exceptions) more memorable," it is in all likelihood more successful in shaping people's understanding of science than formal science education (1104). But scientists often dismiss popular culture representations as unrealistic, excessive, not truthful, unimportant for their own work. Van Riper argues that if popular culture is to serve as a potent "shared frame of reference" for the communication of research results, scientists need to take it more seriously, both as a form of entertainment – or infotainment – and as "a springboard for dialogue with the public" (1107). Formulated in 2003, this argument still rings true today. Where I disagree with van Riper, however, is in his assertion that popular culture can provide a "teachable moment" in which scientists can reinforce their concepts (1107): This assertion positions lay public

and society and the personal consequences of (bio)technologies as well as ethical decisions about their use.

10 This is all the more important because scientific findings and data always need to be understood in the specific framework of how they were generated, with all the limitations and contingencies that entails.

and expert scientists in imbalanced power relations and thus reflects an outdated division into spheres of competence. Instead of seeing this relationship as a two-way street, it enforces a one-way, paternalist relation that undermines the very idea of a sustained dialogue about the fears, anxieties, concerns and hopes expressed in relation to science and biotechnology. These can, however, find their expression in a popular culture in a different guise: more personal narratives and stories. Listening to medical stories, as the Medical Humanities have shown, can make individual experiences more relatable, create social impact and empathy. Narratives and language, those tools traditionally used to make complex processes more graspable, can provide exactly the platform needed to make sense not just of scientific knowledge but also of its repercussions for one's own life.

Role of Language and Narrative

Studying such narratives can reveal the structures through which the public makes sense of new interventions, technologies and innovations. Language and narrative, it becomes clear, play a crucial role in the production and perpetuation of biological knowledge through media and the channels of culture. As Lupton writes, we can use the study of discursive tropes – patterns of words, figures of speech, concepts, symbols, ways of describing, categorizing, making sense, implicit values and judgements – to show the intertwined, mutually reinforcing relationship between discourse (the "way we speak or visually represent phenomena") and practices (actions, activities around the phenomena) (*Medicine* 18-19). For example, how we represent diseases can impact how we react to and interact with those affected: Multiple Sclerosis, as one example, often is represented through visual aids such as crutches or wheelchairs. This type of representation, however, risks negating more "invisible" forms of the disease, those that do not explicitly leave marks on the body while at the same time marking people with MS as differently abled, potentially influencing how others react to the diagnosis and in interactions with those affected.[11]

As we can see, discursive approaches are important because people construct their understanding and beliefs about medicine from personal experience, interaction with others as well as with cultural products: Mass media and narratives become influential ways of shaping perceptions, contributing to people's understanding of medical phenomena. They provide a medium through which we can access socio-political changes and challenges, structures of feeling, prevalent beliefs and values. Stories register and transmit cultural assumptions, concerns and anxieties as well as norms and values across cultures and time periods (Wald and Clayton viii); they can be seen as textual

11 My master's thesis dealt with exactly this ambiguity in the representation of invisible disabilities, more specifically Multiple Sclerosis (MS), in American popular culture. MS, as a largely invisible illness, *becomes* visible, is *made* visible through conscious acts of translation and representation. These representations can have an impact on how individuals experience disease and how society reacts to them. I argued that the most productive representations of MS make use of in/visibility, being both visible and invisible at the same time, to portray MS as the highly fluctuating disease it is (Grewe-Salfeld, *A Dialectic of (In)Visibility: The Cultural Imaginary of Multiple Sclerosis*, 2016, unpublished).

representations of current concerns. We can therefore use narrative to understand the present, to show how the contemporary world was and is made into what it is, in order to shape the future: Narrative makes visible some of the broader concerns in contemporary culture, not just but also related to biomedical technologies. Analyzing the stories of illness and health, as it is done in the Medical Humanities, can elucidate how people make sense of their experiences in the medical encounter, how they construct their identity and frame their confrontation with their own biology. The in-depth study of texts that is crucial to discourse analysis in narrative medicine can therefore be seen as a means to analyze changes and social processes because texts – broadly understood in Cultural Studies – can gives us access to the lived experience of everyday life. A contemporary example is the movie *Still Alice* (2015) that shows a woman in her early 50s tackling a diagnosis of early-onset Alzheimer's, providing insights into the firsthand experience of the disease and its effects (Glatzer and Westmoreland).[12] Many more of such illness narratives can be found in culture, many of them following similar structures, as Arthur Frank pointed out in his seminal text on the *Wounded Storyteller* (1995/2013).[13] Renditions of such narratives can be found in contemporary social media such as *Facebook* and *Instagram* as well. These platforms make the sharing of such personal narratives of disease much easier for individuals, allow their voices to be heard in a wider audience and shared in 'their' (biosocial) community. Such accounts can give patients agency and authority over their own experience (cf. Hinson and Sword).

Scientific and biological information circulates through language, images, stories and thereby is part of the circuit of meaning production in popular culture: the vocabulary used, the norms espoused, the judgments made, in this context shape the public understanding of science. Nancy Tomes, for example, traced how fears and desires were used by journalists, advertisers and in the products of popular culture to turn epidemics into entertainments ever since the beginning of the 20th century: Her examples include more common diseases such as Tuberculosis – or more recently AIDS – as well as unusual diseases like Parrot Fever, that contributed also to the dispersal of scientific innovations and information into the public sphere.[14] Disease, and with the

12 *Still Alice*, the movie, is based on an eponymous book written by neuroscientist Lisa Genova inspired by the Alzheimer's diagnosis of her own grandmother. After the success of *Still Alice* (2007, on the *New York Times* bestseller list for 40 weeks) Genova has continued to combine her neuroscientific education with her literary talent to write a series of books about people with neurological diseases or problems. The movie received an Academy Award for Best Actress in 2015.

13 In *The Wounded Story Teller* (1995/2013), A. W. Frank distinguishes three different types of illness narratives: The Restitution Narrative, in which the patient is restored to health through science and medicine; the Chaos Narrative, in which, often retrospectively, illness is narrated as an interruption that lives from the silences and disruptions that illness (or the impossibility of putting its experience in words) entails; and the Quest Narrative, that describes the experience of illness as a journey, also of personal transformation.

14 Tomes claims that disease and epidemics have gained a new cultural visibility due to modern communication media and the new globalized threat they pose. The templates of disease used in contemporary accounts of germs, viruses and epidemics, however, are traced to developments in the early 20th century and the parallel rise of the germ theory of disease and new mass media. In news media accounts and journalism, in particular, the increasing use of stories of disease also served to perpetuate scientific facts out of the laboratory or clinic into the households of the masses. More-

increasing sway of science scientific explanations and technologies as well, have always been part of the cultural imaginary, the narratives and representations circulating in a culture. This is not just true for technologies that already exists today but also for those of tomorrow. Narratives in novels, films, or visual media readily dramatize possible implications of discoveries and interventions, and thus provide a good medium to think through technologies *before* they are developed or widely in use. Concerns about science often arise out of "popular science predictions and speculations" about advances that are "just around the corner" and are thus not based on real experiences and evaluations (Rose, *Politics of Life* 78). Rather, we find a recourse to speculative narratives and science fiction when the future of biotechnology and biomedicine is discussed. Much of this is left to our imagination. Technological imaginaries as they are developed in science fiction do not just speculate about the future on the basis of current technologies, but also tell us a great deal about the fears and concerns connected to technological advancements. Technological imaginaries influence the public understanding and response to biotechnology and create fears and expectations about the future (Stevens 269). In fact, the struggle over the popular imagination – genetic imaginaries, biological imaginaries, cultural imaginaries – can be understood as a larger struggle about the future: What is imaginable, in the most literal sense, becomes desirable and doable for some or objectionable and deterrent for others. In either case, it can shape popular attitudes and judgements about applications of biotechnology and thereby change their prevalence and use.

When what is imagined transcends what is currently feasible, such imaginaries can also serve as imaginative prompts for further research and development. The imaginaries about science created in popular culture shape not just the public understanding, reception or response to biotechnology: Films and biotechnological imaginaries play a role in shaping technologies and research as well as their use and acceptance. Such linguistic and visual representations of science in culture are always political and reveal the affective structures behind the acceptance or disapproval of biotechnologies in society: They serve to reinforce dominant bio- and body politics, ideologies and norms at the same time as they reveal deeper cultural anxieties about the (future) health and state of the corporeal body, the expanding medical control of bodies, the specter of categorization, deviance, and "newgenics" (cf. Lupton, *Medicine* 78). Imaginaries, moreover, create and perpetuate promises about the (future) state of the body, its potential for modification and optimization. Through this type of imaginative engagement through language, we can see how culture and technology are intimately related. In "complex feedback loops" culture and technology constantly remake one another (Stevens 5).

Science and Culture

What is needed, then, is to culturalize science and biotechnology, to subject them to careful cultural analysis of their epistemic practices, to make these practices visible as

over, the portrayals of disease, she writes, also were closely aligned with rising consumer culture: Narratives of disease were not just a source of cultural anxieties but also highly profitable, selling cultural productions, stories and products – selling disease (cf. Tomes, *Epidemic Entertainments*).

cultural, to show that their claims are premised on categories that are cultural, historically and locationally diverse and contested (cf. Steinberg 155, Kunow). Science is generated in and from culture – "from language and discourse, actions and practices, representations and material cultures" – and "spread through our society and culture, unfolding in multiple domains and in multiple forms" (Erickson 1). (Popular) culture here opens up as a particularly influential and contested domain. It is influential because it has a high impact on individual and collective judgements, contested because its position is not universally acknowledged, especially by scientists, because much of what it produces seems to violate the norms and standards of the scientific method. Still, according to Stevens, popular culture, more than anything, feeds the hype around biotech by fueling expectations and foreshadowing the future. The scientific and biotechnical imaginaries created in popular culture influence the direction of research and therefore how biotech develops. But most importantly they influence how people understand and use science (8). As affective structures, "hype, promise and fear," Stevens claims, need to be part of the cultural analysis of biotechnology (8-9). Here, we begin to leave the realm of constructivism and move into considerations of the material nature and multiple assemblages present in and shaping our engagement with biology.

2.2 Promissory Bodies and Plastic Life

Attention to the material conditions of life and knowledge production has in the past years been more and more acknowledged as the basis for an extensive critical analysis of culture. As a result, the body has increasingly moved to the forefront of academic analysis: Its lived experience, embodied reality, use and abuse in culture have come to be favored topics of research. In a first 'turn' towards the body and its experience, researchers argued that the social body would not exist without the natural, biological one and that they both influence each other. The body became political and symbolic, a contested terrain but also a fundamental aspect of cultural-critical inquiry. Many of these cultural approaches to the body looked at how bodies gain symbolic significance through cultural construction. The concept of the socially and culturally constructed body, perpetuated in such theoretical engagements, variously positioned the body as determined by language, shaped by discourse and representation which are historically and culturally contingent (following Foucault) or produced at the intersections of power relations. Traditionally, social constructionism with its high emphasis on language, meaning, and representation tended to subsume nature into culture, to give culture power over nature. The body was inscribed by culture, a surface to be read and coded, a place where social relations are manifested (Pitts-Taylor, *Cultural Encyclopedia* xxii–xxiv). The body became a screen, a blank piece of paper onto which cultural discourse writes its story – what is materially there, and how that shapes the story to be told was less important. The materiality of the body, its biology, had no agency in this process, it is a passive recipient instead of dynamic. Such a constructivist critique is useful, even necessary, to counter determinist and reductionist claims, to highlight cultural and historical diversity of experiences as well as the social organization and basis of inequality (Pitts-Taylor, *Brain's* 7). While it was certainly also a big influence on my

considerations in this book , it is, nonetheless, no longer enough to adequately capture the lived reality of embodiment today. What is needed (in addition) is a new appraisal for the *material* basis of life, of bodies, and how it interacts with social constructivism, with culture and meaning ascription.

In the last decades of the 20th century, and the first decades of the 21st, academic considerations of human life have begun to enrich concepts of the body as socially constructed and culturally malleable with more and more in-depth considerations of the body in its materiality. Scholars increasingly turned their interest towards how people *experience* their own bodies, on the phenomenology of individual embodiment (Pitts-Taylor, *Cultural Encyclopedia* xviii -xix).[15] What is often termed "new materialism" – in Pitts-Taylor's words, a "reaction" to the focus on linguistics, discourse and representation in the 20th century ("Mattering" 2) – has its theoretical roots most prominently in feminist and queer studies.[16] Feminist scholars have long addressed the complex relationship between the material body and its social enactment or performance, especially in the context of sex and gender.[17] Younger (feminist) theories show the body as defined by multiplicity and potentiality, such as two scholars who have been influential for my considerations, Bernadette Wegenstein and her discussion of body modifications and the cosmetic gaze, most prominently in *Getting Under the Skin*, and Victoria Pitts-Taylor's theorization of brain plasticity.[18] According to Marc Chrysanthou, this "bodily turn" in contemporary theory is symptom of the wider cultural fragmentation and disorientation in postmodernity – creating a "disorientating ontological insecurity that predisposes the postmodern self to take uneasy refuge in the most basic shelter of all: his or her own body" (470). The body, in lieu of other forms of safety, security, or anchoring, becomes the primary target of the self, a safe harbor but also the last frontier that can be controlled or shaped by the self (even though it does not fall outside the realm of social control). According to influential theorists like Anthony Giddens or

15 Often the basis for such thinking is a renewed interest in phenomenology, along the lines of Merleau-Ponty, as Wegenstein argues. Merleau-Ponty stresses the "interdependence of body and world," where the world is experienced through the lived body. Wegenstein writes: "Whether maintaining a constructivist, a performative, a volatile, or even an essentialist account of the body, all of these ways of thinking of the body presume that the body is access to the world (given, construed, performed, or even all at once)" (*Getting* 30-32).

16 A key text on new materialism is Coole and Frost's *New Materialims. Ontology, Agency and Politics* (2010), in which they collected a range of critical works that exemplify the new engagement with matter, materialization, human embodiment, agency and our material surroundings.

17 Most prominently J. Butler in *Gender Trouble* argues that the biological, material body is shaped through the performance of gender, that the body becomes a process of enactment.

18 In their accounts matter is not passive (recipient of social meaning and social constructivism) but dynamic – having agency of its own, always interacting with the social and cultural. This shift leads to a renewed understanding of the relationship between nature and culture: It shows that matter and culture determine each other, are not separate or even separable, but in constant interaction, imbricated in a network of different actors, forces, and affects. According to Nick J. Fox, the ontological focus changes from single "entities to relationality." Rather than focusing on what human bodies and identities are, consideration is given to the networks and assemblages they are part of, to flows of affect in social production rather than solely human agency (N. J. Fox 138-39).

Chris Shilling, the body has become a space of self-expression, a project to be worked on as part of one's identity formation.

This is a very much future-oriented and -directed view of the body, concerned with the *potentiality* – or if we wish, the promises – embedded in its materiality. In postmodern culture, Victoria Pitts argues, the body is no longer seen as "fixed and pristine or as subordinate to the self;" instead it is seen as open to manipulation, in its aesthetics, norms and possibilities. The body becomes open for new symbols, meanings, options, she claims, often involving temporary or permanent modifications of the body through hard work, cosmetics, chemicals, or technologies, all of which somehow sculpt, transform, reshape it in some way or other (through painting, cutting, implanting, transplanting, extending, lasering, suturing) (29-30). This openness to modification – in the present, for the future – through technology has changed how we think about what it means to be human, what it means to have a body. The bodily turn in theory has disseminated new means of theorizing human embodiment, identity construction and the lived experience of our materiality. In this subchapter, I want to delineate and focus on four of them: the somatic self, the concept of life and the body prevalent in contemporary discourse, the idea of plasticity, and theorizations of affect.

The Somatic Self

Interest in the body is also very much present in culture and society at large. The body has become a focal point in questions of identity, normalization, control, self-expression, and optimization in the name of the (global) market. According to Brian Turner since the second half of the 20th century we have lived in a "somatic society," a society in which the majority of problems – moral, political, social – are framed in and through the body. A major driving factor for Turner are the socioeconomic changes connected to the expansion of medical technology and discourse to more and more areas of life: In this way the body was again and again framed as biological, in need of medical intervention, but at the same time subject to economic forces. According to Rose, we sense ourselves as "biological creatures, biological selves" whose vital existence is increasingly subject to (self) control and exploitation in the contemporary molecular politics of life itself (*Politics of Life* 4). This view of the body and self as inherently biological leads to an intrinsic connection between bodies and selves: the self becomes the body, meaning that work on the body equals work on the self, that separations between inner and outer, mind and body dissolve.

Selves today are embodied and biologized (Davis and Morris 418) and in consequence questions of identity are no longer seen as separate from the body. The individualization of bodies, historian Norbert Elias argues, had begun in early modernity, when with the separation of individuals from a broader social body a concomitant process of differentiation took place. Instead of an undistinguishable mass of people, individuals, their bodies and problems slowly began to take center stage: medicalization, especially the medical gaze developed throughout that time, focused on the body at hand – the body on the table – and "dissected" it with a view to individual causes as well as socio-environmental factors. The individualization of life (choices) then cannot be seen outside of the individualization of material bodies. In this way, individual bodies were un-

derstood in biological terms and any form of intervention acted on the biological body. Similarly, according to Anthony Giddens, modernity led to a pervasive sense of ontological insecurities by cutting self-identities loose from traditional (community-based) forms of identity (*Modernity and Self-Identity*). Identities became destabilized. Shilling, taking up Gidden's theme, argues that the response of the self to this uncertainty is to "refocus the source of identity and meaning on the body" (Chrysanthou 470-71). The body, thus, in postmodernity has become a primary source and expression of individual identity.[19]

As Rose writes, we increasingly relate to ourselves as "somatic individuals:" "as beings whose individuality is, in part at least, grounded within our fleshly, corporeal existence," whose body is a "key site for work on the self" (*Politics of Life* 25-26, 18). The body has been framed as a "project" to be worked on as part of the construction of individual self-identity (cf. Shilling 5). All around we are confronted with perpetuations of this demand for self-realization through the body (Wegenstein, *Getting* 4-5). From official discourses of health promotion to mass media or popular accounts of disease and health, dieting and fitness regimes, we are urged to act on the body, to construct and reconstruct it (Rose, "Politics" 18). "Our bodies have become ourselves," writes Rose, they are "central to our expectations, hopes, our individual and collective identities, and our biological responsibilities" (*Politics of Life* 105). This "somatic self" goes hand in hand with the (market) ideal of the autonomous individual of Western liberal democracies: this self is "free yet responsible, enterprising yet prudent, conducting life in a calculative manner by making choices with an eye to the future" (Rose, *Politics of Life* 111). The consequence of this somatic individuality is also an increasing responsibilization of this individual for their health and well-being. The somatic self, in the end, is the one that makes decisions about their material body and vital existence, a body that is increasingly seen as in itself malleable and fluid. This somatic selfhood, thus is both liberating and highly restrictive, luring with its emphasis on choice and autonomy but also oppressive through new webs of control, responsibility and domination – question that will come up in the subsequent subchapter once more.

A New Body Concept

How then do we conceptualize a body, how do we approach bodies, in a world that puts as much emphasis on them? Both in the social sciences and cultural theory and in the biological sciences organisms today are seen not as singular and universal, but as varied, plastic, part of dynamic systems and environments (Pitts-Taylor, *Brain's* 7). Our understanding of the body through its biological materiality, thus, is characterized by a new focus on interactions and situatedness. The concept of the body, used also in discourses of DIY biology and medicine, however, is not only a reflection of this new dynamic view but also incorporates older, deeply engrained views of the body. In the following, I will briefly introduce different conceptualizations of the body – from the mechanistic view and the "body-in-pieces" (Wegenstein), towards the "biomediated"

19 cf. also Giddens, *The Consequences of Modernity*.

(Thacker), commodified and malleable, posthuman body – and then delineate how the techniques and technologies of DIY biology and medicine make use of them.

Bodies historically underwent a process of fragmentation: They were divided into individual "body parts," individual processes and structures to be studied and described, delineating the body into ever smaller chains of cause and effect. Much of this process was dominated by a *mechanistic language*. Following Lupton's narrative in *Medicine as Culture*, the conception of the body as a form of "machinery" is one of the longest-lasting approaches to the body, that is very much reflected in discourses around the body until today: Mechanical metaphors, such as clockworks or hydraulic machines, are often used to convey the inner workings of the body. The heart as a pump is probably one of the most salient one of these. Mechanistic views restore a sense of order, rationality and predictability in a highly complex and hardly understood organism. By implying that body parts can be as easily replaced as machine parts, however, this view of the body places more emphasis on treating the problematic part rather than looking at the system as a whole. During the past decades, machine metaphors have largely been replaced – to the same effect – with metaphors of the body as a computerized system: examples here include the view of the brain as a form of information storage or memory hardware and the bio-informatic metaphor of DNA as a genetic "code:" "They are reworkings of the mechanical metaphor in representing the body as being comprised of a multitude of tiny interchangeable parts, rendering the body amenable to objectification and technological tinkering in the interests of developing the 'perfect' human." (Lupton, *Medicine* 59-61) According to Stevens, biotechnology is premised on this idea that "understanding life requires understanding it on a submicroscopic level," that it "works something like a machine: it has moving parts that can be taken apart, modified, and put back together again" (345). Stevens stresses that such a view of life "suggests particular ways of tinkering with and thinking about organisms," of engineering life itself (345).[20] The body, in this mechanistic view, is reduced to individual parts: from limbs, to organs, to molecular structures – it becomes a 'molecular body.' This perception of the body, however, "as mechanical device or a 'human motor' which can be controlled and regulated by biomedical interventions" has been criticized by social historians of medicine already since the 1970s (J. Tanner 38). It is regarded as simplified and indeed potentially limiting through its reductionism (Nesse). The ongoing use of mechanistic metaphors of the body, however, have engrained such a view and given it currency.[21]

In Bernadette Wegenstein's concept of the "*body-in-pieces*" the body is split into parts as well, but she complements this reductionism with a wider view. Wegenstein argues that since the anatomical fragmentation in the 15th and 16th century, but especially

20 The question then, is what does the view of the body as mechanistic, as a collection of parts – or in the more reductionist language of biotechnology, a collection of cells and molecules – to be changed, enhanced, modified, mean for subjectivities of people? The biotechnological premise of the mechanistic-computerized body requires the subject to change their conception of their own body: In order to use and accept such techniques and technologies, I need to adopt this view and think differently about my own body.

21 Also in seemingly 'progressive' ideologies such as transhumanistic ideas, humans are often seen as "no more than a sum of their physiological processes, which are entirely mechanistic, knowable, and controllable" (Tirosh-Samuelson n.p.).

with the constitution of the gaze of medicine since high modernity, the body concept has changed from a unified perception to the "body-in-pieces," fragmenting and decomposing the body into ever smaller and more controllable units that are perceived as working independently from each other (*Getting* 3-8). Towards the end of the 19th century, she claims, a more holistic view of the body emerged – "defined as the interrelation of all (body) parts-in-pieces" – in the end leading to the incorporation of early modernity's fragmentation into a holistic view of the body (*Getting* 24). The body-in-pieces is thus characterized by a fluctuation between fragmented and holistic body concept, "… a dialogue between the body as a whole and as a multiplicity of fragments" (*Getting* 35). In the practices under examination in this book, especially those targeting the human body, we can see a similar fluctuation between and integration into each other: While the fragmented body-in-pieces – or the 'molecular body' – is the basis for much intervention (into single, molecular units), these interventions target the body as a whole – a holistic view of the body that also incorporates notions of wellness and psychological health. Through its fragmentation, it is believed, the body can be made 'whole' again.

Contemporary technologies, however, pull our body concept into even more complex directions. Eugene Thacker develops the concept of the "*biomediated body*" or informational body to address the increasing mediatization of the body. For Thacker, the body is both a medium ("a means of communication") and mediated ("the object of communication") (Thacker 55-56).[22] The mediated body seems to be a bit more approachable than the idea of the body as a medium. For Thacker, the body as a medium means that the "techniques and technologies are not external to or qualitatively different from the body," not developed to operate on or control the "natural/biological" world but generated from within: In biotechnology, the body becomes the technology or instrument, the medium, when "the material components and biological organization of the body" are "rematerialized, renormalized, even redesigned" (Thacker 57-58). Tacking up Thacker's concept, Patricia Clough argues that the biomediated body is informational: it "exposes how digital technologies, such as bimedia and new media, attach to and expand the informational substrate of bodily matter and matter generally" (Clough 207-08). The body here is seen as information and data, a view that also rests on the idea of DNA as code. Such a biomediated, informational body raises another specter: What happens when the body becomes not just an assemblage of disconnected, repairable and replaceable – but still material – parts but an (impersonal and immaterial) set of data and information? Also in DIY biology, especially when it comes to tests for bodily conditions, the simple availability of information can already have an immense impact on the body.

In all this, it should not be forgotten that due to its embeddedness in global capitalism, the body has also become *commodified*. Already in 1994, Deborah Lupton notes that the body has become a "consumer commodity which must be groomed to achieve maximum market value" (36).[23] The narcissism in Western societies with its "obsession with

22 Apart from biotechnologies, Thacker's examples include older techniques of the body as well, such as fashion, tattoos, cosmetic surgery, body building, or cyborg performances ("What is Biomedia" 55-56).

23 Here I follow Lupton's narrative in *Medicine as Culture*.

physical appearance, the purchase and consumption of commodities and the construction of self-identity" means that how people define themselves is closely linked to how and what they consume (36). One of these new commodities is the body. Bodily maintenance has become an area of discipline and control: In order to market it well and maximize its efficiency, servicing and care for the body, often through lifestyle adaptions, is needed. The obsession with youth and beauty as features of desirable bodies have generated a whole industry devoted to bodily maintenance. This notion of the body reinforces the idea that the body can be reshaped to fit accepted notions of appearance, productivity and efficiency (*Medicine* 36-38). Stefan Selke likens this view of the body to Bourdieu's notion of capital. According to Selke, as a project the body is endowed with a new status: health is turned into an alternative religion, the body into a lifestyle product and "temple." As such, the body becomes a new form of capital: to others and one self, health and fitness signal discipline and attractiveness, which equal status and power in society. As Selke argues, one has to "invest" in this capital both physically, psychologically and materially because health is needed to make full use of it. The individual is turned into a "manager" of her bodily capital.[24] Correspondingly, the body is seen as a resource that can be worked on and with – in Selke's words "bearbeitbares Material." This implies a mechanistic and functionalist view of the body, one in which the body can be taken apart and repaired, either self-directed or in what Selke loosely terms "body workshops" (my translation). In this view, the human is no longer a subject but an object, life a project in which the investment in body capital becomes a daily, individual task ("eigenverantwortlich"), complete with sanctions for non-compliance (Selke 59-60). Today we "replace our identities [and bodies] with market-driven, slightly altered, and improved ideals of ourselves" (Wegenstein, *Cosmetic Gaze* 125). Biotechnologies have turned life itself into "a productive force to be harnessed, technologized, and capitalized," and thus become part of the circuit of capital and its regimes of speculation and risk (Stevens 77). This commodification becomes explicitly present when talking about body modifications and enhancements and should thus be mentioned here. As Debra Shaw claims, "[a]s life itself, understood as bio-genetic information, becomes commodified, it equally becomes manipulable and hackable" (289). This view, of course, is also foundational for the practice of 'body-hacking' under consideration in this book.

Posthumanist thinking takes up this notion of malleability and potentiality of the body. In her treatise on *How We Became Posthuman*, N. Katherine Hayles argues that it is exactly the acceptance of a malleable, manipulable body that heralded the era and rise of the "posthuman." She argues that we have become posthuman in the moment the results of the Turing test were accepted: This test set out to discern whether or not people could differentiate between artificial intelligence and human intelligence by

24 It is noteworthy, as Selke argues, that this capital can also only be demonstrated, performed, or symbolic (59-60). Body positivity can be regarded as a 'bottom-up' counter movement against such beauty and performance standards. Body positivity promotes the acceptance of all bodies, regardless of physical ability, size, gender, race, appearance. Currently, a new wave of body positivity is promoted and critically discussed on social media – in response also to discriminating beauty standards on social media – and used in marketing campaigns.

"talking" with the other (computer or human) through questions and answers. Recounting Hayles' argument, Christina Lake summarizes that not the test itself or its results were important, but how it was framed: Following a Cartesian dualist thinking of mind and body, it favored information/mind over embodiment. The body here becomes "the original prosthesis we all learn to manipulate, so that extending or replacing the body with other prostheses becomes a continuation of a process that began before we were born" (Hayles 3). The body is simply a resource to be manipulated, it is plastic, can be reshaped with whatever enhancement technologies are available (Lake 14).

All the ideas mentioned above, I argue, come together in how we frame the body in DIY biology and medicine, but also culture and society at large. The contemporary concept of life and of the body – as it is embodied in the cultural representations and material practices under examination here – is in its basic convictions still *reductionist*, meaning looking for the smallest common denominator, but also *mechanistic-systematic*. What do I mean by that? Contemporary discourses of the body see parts of life and parts of the body as both exchangeable and repairable *and* as embedded in larger networks or systems. They highlight their complexity and malleability at the same time. This view is, taking inspiration from Wegenstein's ideas on fluctuation, produced by the incorporation of mechanistic thinking into systems theory and network thinking. DIY biology relies on a view of life as rearrangeable (mechanistic) but has also incorporated more complex, even holistic ideas of the body (systematic). The result is a mechanistic-systematic, highly malleable concept of the body.

From Brain Plasticity to the Plastic Body

The notion of plasticity summarizes much of what has been said before in a neat new concept. With the reconceptualization of the brain as constantly adapting and the rise of epigenetics, plasticity has emerged as somewhat of a new master narrative in the natural sciences. More and more bodily processes are no longer seen as fixed but as ever-changing and adapting through outside influences.[25] But the triumph of plasticity has not stopped there: befitting of our current demands of constant mobility and change, it has also been adopted from the realm of biology and applied to social and cultural questions – again situating biological processes in their time and place, linking nature and culture.

Originating in 18th century materials science, the term "plasticity" was originally used to describe the malleability of matter (in the broadest sense). During the 19th century, then, it shifted towards a biological meaning and was used to describe the ability of organisms to adapt when faced with environmental changes (Berlucchi and Buchtel). Following this line of thought, the idea of plasticity was often applied in the context of cell culture and later brain science. As Hannah Landecker delineates, after the rise of cell culture – the ability to grow, divide, multiply cells in vitro, to create cell lines and

25 cf. for example Victoria Pitts-Taylor on the plastic brain in *The Brain's Body* (2016), Pitts-Taylor on our contemporary engagement with matter in *Mattering: Feminism, Science and Materialism* (2016), Hannah Landecker on cell culture (2005), Berlucchi and Buchtel (2009) on *Neuronal Plasticity* or Andy Clark on plasticity and embodiment (2007).

work with them – "being a cellular entity … means being freezable and open to artificial synchronization; any live thing made of cells, after these interventions, becomes an object that can be stopped and started, suspended and accelerated" (n.p.). The plastic matter of the organism, cells and with them their accumulation in the form of bodies, has come to be seen as manipulable through (human) intervention. For her, then, the history of biotechnology in the 20th century is mainly characterized by the "increasing realization and exploration of the plasticity of living matter" (Landecker).

This exploration of plasticity has in the past decades reached the brain: In contrast to older views which saw brain development as stopping during the first decades of human development, contemporary narratives frame it as constantly creating new synaptic connections, modifying itself in response to outside and inside influences. In her recent (2016) examination of the corporeal politics of brain science, Victoria Pitts-Taylor closely examines this notion of neuronal or brain plasticity. In Deleuzian language, she claims, brains are "biological *becomings*, always in process, always open to transforming themselves and being transformed" (*Brain's* 17). This openness, as a next step, allows us to transform who we are, gives agency both to people and matter (*Brain*'s 17-18). Plasticity thereby denotes both the brain's material potential and the possibility for modification and enhancement (*Brain's* 24). Moreover, with the advances in genomic knowledge since the publication of the Human Genome Project at the beginning of the 21st century, genetics came into the purview of plasticity as well. Epigenetics describes the process by which genes are expressed – 'switched on' or 'turned off' – through molecular processes as a reaction to the intracellular environment and external environmental factors. Epigenetics stresses the plasticity of genetic matter and is, like brain plasticity, a "medium through which social and environmental experiences materialize at the molecular level" (Pitts-Taylor, "Mattering" 5-6).

Plasticity, thus, can be seen as an umbrella term for all sorts of biological processes, one that is procedural in that it connotes a basic principle or process rather than the thing itself. Correspondingly, the notion of plasticity lacks a clear-cut definition; on a basic level, however, plasticity is used to describe the processual nature of events, entities and bodies, their state of perpetual *becoming*, their ability to change and be changed.[26] Plasticity can be seen as the *material potential* of living organisms in general.[27] When defined as plastic, living bodies (human or animal) are thought to possess an ongoing capacity for renegotiation (Clark 268). Plasticity highlights the contingency of biology and embodiment, and thereby also obliterates the distinction between nature and culture. According to Pitts-Taylor, the plastic brain challenges the old separation of mind and body, culture and nature, by collapsing the distinction between brain (as biological) and mind (as immaterial, discursive, symbolic) (*Brain's* 4-5).

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26 Other biological examples of plasticity can thus include evolutionary adaptation (though this is a rather slow process of plasticity), or – with a view to genetics – the variability of phenotypes and genotypes in monozygotic twins, how environment, microbiome and epigenetic factors can impact gene expression.

27 As quoted above, Pitts-Taylor, in *The Brain's Body*, refers to plasticity as the material potential of the brain (24). Given the widespread circulation of the idea of plasticity, I would expand this idea towards (whole) bodies and living organisms more broadly.

The ideas implied by plasticity – dynamism, interconnection, network thinking – to a certain degree seem to be contesting mechanistic ideas of the body. But it should not be forgotten that these ideas were what formed 'plasticity' in the first place. Our contemporary mechanistic-systematic view of life and the body is in its foundation a mechanistic view of life 'upgraded' to fit contemporary network-thinking: it acknowledges both the hardware (the material body) and the software (the network of multiple connections) as being replaceable, repairable, taken apart. Plasticity, then, is a more integrated view of life, one that combines hardware with software and the environment in a fruitful way. Especially for conceptualizations of the body that look favorably at trans- or posthumanist thinking, plasticity seems to be the way into the future. The view of the body as plastic, for Andy Clark, means that humans are biologically predisposed for recalibration, reconfiguration and extension: "It is our basic, biologically grounded nature…to be open to a wide variety of forms of technologically mediated enhancement, from sensory substitution to bodily extension to mental extension and cognitive reconfiguration." (Clark 278) For him, our basic nature is plastic. Clark here argues for more attention towards the plasticity of embodiment, in the sense that humans are able to incorporate new "equipment" into their "systems," making possible all kinds of enhancements such as human-machine interfaces (Clark 264).[28] While I would not go as far as blindly espousing transhumanist ideas – they pose their own questions and concerns after all – a view of bodies as plastic shapes our definitions of who and what we are, can or will be in the future. Here, the concept of the plastic body becomes important for DIY biology and self-directed enhancements. According to Nikolas Rose, individuals can today think of their bodies as open to modification: "Our somatic, corporeal, neurochemical individuality now becomes a field of choice, prudence, and responsibility. It is opened up to experimentation and to contestation. Life is not imagined as an unalterable fixed endowment." (*Politics of Life* 40). In other words, the body as plastic opens many new possibilities of playful and strategic engagements with bodily materiality. But this new form of engagement also creates new forms of responsibility.

This paradigm of plasticity has also found application outside of the natural sciences. For example, theories of neural plasticity underpin the study of affect – the capacity to affect and be affected on levels below consciousness – in Cultural Studies.[29] The new materialist orientation of social and cultural theory, furthermore, seems to incorporate notions similar to plasticity into its reflections on the relations between humans, non-human animals, things and capital (Pitts-Taylor, "Mattering" 5-6). Plasticity, thus, has also encouraged theories of late capitalism and the global market place. Emily Martin, for example, argues that the global marketplace demands an almost manic form of plasticity, encouraging us to be "always adapting, scanning the environment, continuously changing in creative and innovative ways, flying from one thing to another, pushing the limits of everything, doing it all with an intense level of energy focused totally on the future" (E. Martin, "Mind-Body Problems" 578-79). Likewise, Catherine Malabou describes similarities between the idea of neural plasticity and the flexibility,

28 According to Clark, this form of plasticity and adaptability should be corner stones for our conceptualizations of bodies, minds, and persons (Clark 277).

29 A prominent example is Massumi, *Parables for the Virtual* (2002).

multitasking, and self-modification demanded in late capitalism. Plasticity, she argues, can both mean to "receive form," to be modifiable as clay is, and to "give form," to be formative, as in plastic surgery. The plastic brain can create and receive form but it can also be a site of resistance and destruction: It can take form, give form, and resist form (5-6).[30] According to Malabou, this idea of plasticity – so pervasive in fact, that we are mostly ignorant of it – has a counterpart, or evil twin, in the economic and political organization of our life: the flexibility demanded in the work place, the ability to modulate oneself, the high importance placed on mobility, adaptability, efficacy, creativity (10). This flexibility, the "ideological avatar of plasticity," she argues, often "superimposes itself" on plasticity, this positive, promissory, liberating idea (12). The problem is that flexibility only captures one side of the meaning of plasticity, "receiving form," not to give or resist form: "flexibility lacks…the resource of giving form, the power to create, to invent or even to erase an impression" (12), rendering people docile and obedient, bowing to the whim of the market and an economy of flexibility without limits.[31] Malabou here links the brain as a plastic network to the network of current global capitalism, both of which share some of the same core values. Plasticity, in the broadest sense possible, could therefore also be described as a latent cultural condition of our time that extends beyond biology and materiality to society and politics as well.

In the context of biology, plasticity can be problematic as well, visible in what Sigrid Schmitz describes as the paradox of plasticity: It allows us to see the body as biologically malleable and shaped in response to experience (which is positive, also for feminist theorists), but it also describes the body as reduced to its biology, a new form of biological determinism. Here, the question of agency is a decisive factor: Agency in plasticity can either lie with the subject or in the materiality itself. If we see agency as belonging to the subject, this means that for example in brain plasticity the subject can modify her own brain function, for example through technological extension or use of (psycho)pharmaceuticals (Pitts-Taylor, *Brain's* 21). This reinforces notions of the somatic subject, responsible for the management, optimization and enhancement of her biology in the name of the neoliberal market.[32] If we see agency as lying in the materiality itself, however, plasticity also carries with it a certain form of defiance: The body being able to change itself without our knowing or 'consent' challenges what we take for granted or wish to have – that we are in control of our bodies, lives, and selves. It brings our plastic embodiment into the realm of contingency and uncertainty so characteristic of contemporary life. This uncertainty, following this train of thought, is also part of the affective structures that underpin (self-directed) interventions into and modifications of the human body.

30 Malabou deduces this destructive aspect from the French *plastique* or *plastiquer* – used for blowing up things using plastic explosives (5).

31 To rebel against this culture, to "refuse to be flexible individuals" "who have no greater merit than that of knowing how to bow their heads with a smile," for Malabou answers her opening question: "what should we do with our brain?" (78-79).

32 On the other hand, as Pitts-Taylor stresses, this form of self-directed neuroplasticity presupposes a form of the Cartesian body/mind dualism and sees agency as an exclusively human property (*Brain's* 21).

A Short Excursion Into Affect

Since the publication of Eve Sedgwick and Adam Frank's "Shame in the Cybernetic Fold" and Brian Massumi's "The Autonomy of Affect" in 1995, we find a resurgence of interest in affect in various forms and conceptualizations. Many scholars in Cultural Studies have embraced affect as a new critical trajectory as well: Culture is increasingly analyzed along the affects and intensities within social formations. Particularly in materialist cultural critique of bodies, embodiment and (bio)technologies one cannot really find one's way around theories of affect. Since affective structures of desire, fear and promise are one of the most forceful driving factors behind DIY biology and medicine, it is only fitting that some of the core denominators and relevant aspects of affect theory should be included in the theoretical toolbox developed here.

Since the late 20th century, the social sciences and humanities have experienced what can without doubt be termed an "affective turn," the increasing proliferation of theories of affect in many areas of scholarship.[33] This proliferation, however, has not led to a single, generalizable theory of affect – the desirability of such a theory remains questionable in itself – but to multiple iterations of the concept in different contexts. What they all share is their historical antecedents and foundation. Theories of affect need to be seen in the context of a wider critique of theory in Cultural Studies: a reaction once more to the (over)emphasis on the representational, symbolic, language, power in poststructuralism, a call for a return to the lived materiality of bodies and individual experience.[34] It can thus be understood as a critique of and response to poststructuralism, deconstruction and the linguistic turn as well as their perceived limitations and dissatisfying premises. It began to dawn on some scholars that textual approaches cannot fully capture the social world and that the popular oppositions of "power/resistance" or "public/private" cannot alone explain the political process (Hemmings 550). Affect was offered by its proponents as going deeper, capturing also the "qualitative experience of the social world" and embodied experience, but also offering alternative models of subject formation and interrelation (Hemmings 549-550). On the forefront among these scholars were feminists, who with their insistences on the dictum that the "personal is political" had enabled the first sustained scholarship on emotional life and later theorizations of affect (Ben Anderson, *Encountering Affect* 6). But affect is also a concept that can and is seen critically, as somewhat overused in contemporary scholarship for every non-representational effect or configurations of bodies.[35] Still, it is a useful conceptual shorthand, a tool well-suited to capture the affective-emotional driving forces behind DIY techniques.

Lacking a comprehensive definition, affect has been used in different contexts for different purposes and with different critical purchase. Since my use here, admittedly, is a rather broad one, I will briefly summarize some of the defining, overarching characteristics of affect. As Ben Anderson rightly claims, first of we need to acknowledge that there is not one but innumerable affects (*Encountering Affect* 13-14): He lists some of the

33 Many examples can be found in Gregg and Seigworth's *Affect Theory Reader*, 2010.

34 cf. for example Hemmings 554-55, or Clough 206.

35 cf. for example Grossberg, Lawrence / interviewed by Seigworth and Gregg.

contexts in which "affect" has been used as a descriptive term for different phenomena, ranging from "background moods such as depression, moments of intense and focused involvement such as euphoria, immediate visceral responses of shame or hate, shared atmospheres of hope or panic, eruptions of passion, lifelong dedications of love, fleeting feelings of boredom, societal moods such as anxiety or fear**,** neurological bodily transitions such as a feeling of aliveness, waves of feeling," amongst many else (Ben Anderson, *Encountering Affect* 5). As we can see, it is a diverse field in which affect is used. A common denominator, as Lawrence Grossberg points out, however, is that affect is in most cases defined as non-representational and non-intentional (193-95), looking at experiences outside of signification, meaning and conscious reactions. The turn to affect, as Anderson claims, is a "turn to consider the non-conscious or not-yet-conscious dimensions of bodily experience" (*Encountering Affect* 11-12). Or as Seigworth and Gregg argue, "affect" is the name given to "visceral forces beneath, alongside, or generally other than conscious knowing, vital forces beyond emotion" (1-2). In like manner, Gilles Deleuze defines affect as the unexpected autonomy of the body, as intensities which happen below consciousness (cf. Hemmings 551-53).

But affect, like plasticity, is also highly dynamic. On a very general level, Seigworth and Gregg argue, "affect is found in those intensities that pass body to body (human, non-human, part-body, and otherwise), in those resonances that circulate about, between, and sometimes stick to bodies and worlds, *and* in the very passages or variations between these intensities and resonances themselves" (1). Affect is found both in the intensities themselves and in their flow between "bodies." As such, affect is often less observable and more perceptible. Eve Sedgwick's idea of affects as "free radicals" (62) highlights this dynamic nature of affect: Sedgwick's starting point in her discussion is that affects, such as shame, can combine with any aspect of life: "Affects can be, and are, attached to things, people, ideas, sensations, relations, activities, ambitions, institutions, and any number of other things, including other affects." (Sedgwick et al. 19)[36] As such, affect is lively, potent, but also inherently relational. Summarizing Silvan Tomkins take on affect, Hemmings writes:

> Tomkins' work suggests that affects have a complex, self-referential life that gives depth to human existence through our relations with others and with ourselves. In terms of our relations with others, Tomkins asked us to think of the contagious nature of a yawn, smile or blush. It is transferred to others and doubles back, increasing its original intensity. Affect can thus be said to place the individual in a *circuit* of feeling and response, rather than opposition to others. (Hemmings 551-53, italics in original)

For Tomkins affect serves as a connection to others; affect is defined as relational. Similarly, Deleuze defines affect in relation as well: He prominently saw affect as potentiality, namely as "a body's capacity to affect and be affected" (cf. Gregg and Seigworth 1-2). In its relationality, affect thus is collective, extending beyond the individual.

The prospects that come with new bio-medical-technologies generate many different affects: hopes, fears, high expectations, dread. They are celebrated by some, con-

36 For more detailed discussions of Sedgwick see amongst others B. Anderson (2014) and Hemmings (2005).

demned by others. In culture and society, biotechnologies often create anxiety, a "vague apprehension," diffuse, but immediate and unsettling (9); an uneasiness that often is displayed also in representations of biotechnology in the media, policy debates and fiction (Brodwin, "Introduction" 9-10). On the other hand, many of these representations also create a vague sense of hope and a promissory outlook on the future. Much of this is created not through the technologies themselves, the devices and tools, but through the biotech imaginaries in the public sphere: the narratives constructed around them, the speculations about future applications, the simplifications. It is not necessarily the technologies that generate affect but they spark the imagination of the viewer. Promises, hopes, and fears draw on the scientific imaginaries created through (pop)culture. These imaginaries, it seems, produce visions of utopia, by Grattan seen as a "desire or hope that the world could look better than the present" (2). In the cases under consideration here, these utopias are both a perfect and perfectible body and the promise of democratization, participation and control. Sean Austin Grattan in his 2017 work *Hope Isn't Stupid* renounces the prevalence of negative affect in criticism and instead wants to achieve a more complex engagement with affect that "resembles the complexity and difficulties of lived experience" (1). Looking at utopian discourses and the "affective basis for utopian desire" in contemporary American novels, he demonstrates that hope is not as naïve as criticism often labels it, but a complex site of critical inquiry. Grattan frames utopia as "the oscillation between utopian desire and the actualization of that desire" (35). The utopian discourses created by (bio-)technological imaginaries, thus, create a desire and hope for the fulfillment of their promise of perfection and malleability. More than in Grattan's narratives, the desire for the fulfillment of such *promissory bodies* – of bodily utopias – here includes the conscious modification of real bodies.[37] But still, they show that hope, indeed, is not stupid but an inherent part of how we engage with the promises and threats of biotechnological advancements. 'Promises,' therefore, can be seen as inherently affective: they are non-representational in that they are impossible to represent, yet prominently perpetuated by representation; most of the time they are creating a non-conscious desire; they can attach to and shape almost anything (promises can emanate from and target most of what Sedgwick includes in the quote above); and most of all they are dynamic and relational, born in the intersection between bodies, institutions and technologies, in this case.

The role representations play in perpetuating promises, desire, anxiety, makes it useful to briefly focus on one of Ben Anderson's conceptualizations of affect as a "col-

37 Of course, the promissory bodies in biotech imaginaries are also full of meaning and signification. Ben Anderson emphasizes that when analyzing affect representations should not be overlooked, which tends to happen because affect is often theorized as non-representational. For Anderson, representations are part of the collective nature of affect. Despite their somewhat different theoretical conceptualization – standing on opposing poles of poststructuralism and materialism – affect and representation do not preclude each other: "Instead we must pay attention to how representations function affectively and how affective life is imbued with representations." (*Encountering Affect* 13-14)

lective condition" (as in "atmospheres of hope").[38] This conceptualization is particularly useful for a view of affect in a given cultural formation, especially on a collective level. Anderson defines affective atmospheres as a form of collective affects that "envelop" life. For him, affective atmospheres (such as "Obama hope") are impersonal because they belong to the collective situation, but they are felt as intensely personal. This is true for many of the affects that play a role in this book, such as anxiety, desire, hope, or dread. Affective atmospheres, according to Ben Anderson, "may interrupt, perturb and haunt" places, persons, and things; they are not static but – like plastic bodies – always in a process of becoming, "forming and deforming, appearing and disappearing" ("Affective Atmospheres" 78-80). The intangible nature of affect as employed in Anderson's concept of the atmosphere is well-suited to capture how affects shape DIY biology. They are not tangibly there but always present, located in the collective and the personal (without being distinguishable as originating in either of them). In biotechnology, I would argue, 'promise' becomes a collective condition, a unifying principle, yet also something intensely personal, intimate (as it pertains to the make-up and form of individual bodies).

These promises are wide-reaching: Promises of new biotechnologies to cure diseases and enhance your quality of life; promises of enhancement, longevity and personal development, promises for the economy and healthcare system; and promises of democratization and participation. They all shape how individuals engage with biology and biotechnologies. As such, these promises gain a certain degree of power over how people envision, shape and govern their bodies, in the name of health, the marketplace and (political) participation. Affective life, Ben Anderson writes, is "imbued with relations of power" (*Encountering Affect* 7–8). Nigel Thrift, originally concerned with spatial geography and affect as a vital element of cities, argues that we should see affect as political, something that can be manipulated by the powerful for political ends (58). The turn to affect, he claims, creates new political registers, affective collectives and intensities (58). The *power of promise*, then, is not just representational – creating new utopian imaginaries of promissory bodies – but also material and political.

As elaborated on in the previous subchapter, "[a] cultural approach opens up the body to the investigation of meanings and values, metaphors, attitudes and beliefs,…" (Pitts-Taylor, *Cultural Encyclopedia* xxvii). Materialist approaches – be it through theories of the body, plasticity or affect – on the other hand, convince with a much more sustained engagement with the lived materiality and reality of embodiment. The body, its texture and feeling(s), comes to be center stage. It is seen as entangled in its environments, as not just representational or symbolic but real, which paradoxically might result in a new form of biological determinism. The new focus on materiality and the material agency of things can require epistemic practices and old conceptions of power, agency and authority to be questioned (cf. Pitts-Taylor, "Mattering" 11-12). How is matter involved in the production and rehearsal of power relations? How is biology governing and being governed?

38 Ben Anderson delineates different forms of affect that require different forms of inquiry: affect as "object-target," "bodily capacity" or "collective condition" (such as "atmospheres of hope") in different situations and places (*Encountering Affect* 4).

2.3 Discourses of Power, Risk and Responsibility

According to many wide-spread accounts of culture – prominently among them Foucault's – culture is a technology of power, a form of managing populations and societies through surveillance, discipline and modification of behavior, feelings, and thought. While I believe that power is only one, albeit crucial, dimension of culture, it cannot be denied that discourses of power, governmentality and population management have shaped and will continue to form the applications of biotechnology, also in the context of DIY biology. Many of the dominant themes of studies working in the direction of biopower and governmentality – such as the function of medicine as form social control (including the policing of difference and deviance), agency in healthcare settings, power relations, ideology, citizenship, social movements, and risk discourse – influence not just the rise of DIY techniques but how they can and will be used, for what ends and purposes: as tools of empowerment and citizenship practices, as mechanisms of responsibilization, control and subjectification.

Many of those concerns are related to Nikolas Rose's infamous notion of the new "politics of life itself." In response to concerns about new eugenics, Rose delineates a historical shift from biopolitics of populations – where the focus was on hygienics and the regulation of reproduction on the level of the nation as a whole – to ethopolitics, understood as "individual management of the 'somatic' self" (Braun 10). Following a broadly Foucauldian approach, Nikolas Rose argues that contemporary vital politics are "politics of 'life itself'." What does he mean by that? He argues that the vital politics of our time are no longer concerned merely with health or illness or population management per se, but "[r]ather, it is concerned with our growing capacities to control, manage, engineer, reshape, and modulate the very vital capacities of human beings as living creatures" (Rose, *Politics of Life* 3-4). While his treatise of how "life itself" today is brought under the rule of governance, risk, and individual responsibility could already be considered outdated, it still remains a noteworthy influence on many contemporary thinkers. His account of ethopolitics and molecularization has become a standard narrative of the governance of bodies in (medical) culture and should therefore be mentioned here as well. This subchapter will first introduce the theoretical ideas on biopower and biopolitics from Foucault to Rose before moving on to discourses of risk, vulnerability and biocitizenship.

Biopolitics Now and Then

From the 18th century onwards, Michel Foucault argues, the tools through which political power was exercised have shifted from decisions about life and death ("the right to take life and let live," *The History of Sexuality* 136) to the management of life, on the population and individual level. Politics since then addressed the vital processes of human life, such as sexuality, reproduction, birth, death, health, disease, as well as their ordering and enhancement. Foucault uses the term "biopower" to describe the rise of diverse techniques aimed at the "subjugation of bodies and the control of populations" (*History* 140): He differentiated between "anatomo-politics" – those techniques or "disciplines" that aimed at the optimization, disciplining, submission of (individual) bodies – and

"biopolitics" – those that focus on the population as a whole, its health, vitality and regulation (*History* 140). Biopolitics, thus, dealt with daily life concerns such as morbidity, mortality, longevity and tried to address and amend them through public health education, hygienics movements and so forth (Braun 8). While on the first glance the former seems to come into effect in DIY biology and medicine – the optimization and control of individual bodies – DIY, as we will see, might also have potential for the latter: As Foucault writes, the "right" to health and happiness, the right to "rediscover what one is and all that one can be" is one (political) outcome of this bio-power aimed at the facilitation and fostering of life (*History* 145). This right is also instrumental in DIY biology and medicine: The right to know, to tinker, to enhance. But DIY biology and medicine also builds on the age-old fundament of biopolitical strategies of population management that Foucault and later on Rose describe, and future applications might see this side rise to more prominence.

According to Rose, the biopolitical strategies in the early 20th century primarily tried to modify public attitudes and individual judgments (and action) through education and counselling. A good example is the public health movement in the 19th and 20th century, which tried to instill basic tools of hygiene into the daily life of the population through facilitating access to sanitation, social work and the tools of the new media, such as advice pamphlets. This included both maximizing population fitness by encouraging positive habits to promote physical and moral health (preventive medicine and public health education) and improving population fitness by "acting upon the reproductive decisions and capacities of individuals" (commonly called positive and negative eugenics) (Rose, "Politics" 4). Contemporary biopolitical strategies, in contrast, differ from these in that they are no longer oriented on the level of the population but individualized: Health promotion is still its main objective but today states see themselves as enabler and facilitator while the obligation for managing and monitoring health lies with the individuals themselves. For Rose, these new strategies are part of a molecular biopolitics in which a molecular style of thought (focusing on the investigation and engineering of molecular processes) intersects with broader questions of how to govern ourselves and others, with those molecular knowledges at hand ("Race, Risk" 436). Rose identifies five pathways in which mutations occur or have occurred on the way to the contemporary "politics of life itself": *molecularization* – life envisaged at the molecular level, understood "as a set of vital mechanisms among molecular entities that can be identified, isolated, manipulated, mobilized, recombined," echoing a mechanistic view of life; *optimization* – future directed interventions in the present; *subjectification* – new understandings of what humans are or should be, new forms of "biological citizenship"; *somatic expertise* – new ways of governing through new forms of pastoral power and expertise; *economies of vitality* – the search for biovalue, rise of bioeconomics and exploitation of biocapital, furthered by a reductionist and mechanistic view of life (*Politics of Life* 5-7).

The name Rose gives to this dominant biopolitical regime of the 21st century is *ethopolitics*: The new "politics of life itself" goes hand in hand with an increasing responsibilization of individuals to manage their health with "a prudential eye on the future." Patients are encouraged to become consumers of medical and diagnostic services and products, actively and responsibly making choices about their body and health:

"This complex of marketization, autonomization, and reponsibilization gives a particular character to the contemporary politics of life in advanced liberal democracies." (Rose, *Politics of Life* 3-4) Citizens are encouraged to take an active role in their health and well-being: In a "complex network of forces" – between enterprises capitalizing on new health strategies, state advice, private campaigning organizations and self-help groups, medical experts and health professionals – "the health-related aspirations and conduct of individuals is governed 'at a distance', by shaping the ways they understand and enact their own freedom" (Rose, "Politics" 5-7). Disciplinary power is applied through mass screenings, health risk appraisals, fitness tests, health education campaigns that evoke guilt, anxiety, and desires. The rhetoric used is such that individuals remain oblivious of its disciplinary nature and health is promoted as a right and goal for each individual (Lupton, *Medicine* 32). Corrective encouragements, therefore, are seen as benevolent and not controlling: "Thus, in being aware of the public gaze, the individual unconsciously him- or herself exerts disciplinary power, both over others and over the self through self-regulation," Lupton writes. In consequence, power relations are dispersed and made invisible (Lupton, *Medicine* 32). Such a discourse holds true for many of the techniques of DIY biology and medicine: seemingly based on choice and individual responsibility, in truth they are highly disciplinary.

What is noteworthy is that Rose delineates new modes of individualization and collectivization in this process: Individualization here occurs through the processes of responsibilization that turn health into an obligation and expectation and a personalization of the management of the (somatic) self and the body. Despite the dominant themes of such personalization – age-old ideals such as "autonomy, control, responsibility, prudence" – according to Rose we should not forget that this individualization takes place in relation to a collectivity, a biosocial community, and its norms and expectations ("Race, Risk" 436-37). Those parallel processes of individualization and collectivization are interesting because they mirror those prevalent in DIY biology: an individualization of responsibility and a personalization of technologies, coupled with a somewhat abstract sense of collectivization (complete with new social formations and forms of peer pressure) and comparison to a an even more abstract set of data.

Techniques of the Self, Techniques of the Body

The self-normalizing techniques that are so prevalent in the contemporary politics of life are called "techniques of the self" by Foucault: "[T]echniques which permit individuals to effect, by their own means, a certain number of operations on their own bodies, on their own souls, on their own thoughts, on their own conduct, and this in a manner so as to transform themselves, modify themselves, and to attain a certain state of perfection, of happiness, of purity, of supernatural power, and so on" ("About the Beginning" 203).[39] Abend and Fuchs, following Mark Butler's narrative, recount the history of Foucault's techniques of the self from antiquity to modernity and postmodernity. In antiquity, techniques of the self included inward oriented, "care-taking" techniques

39 cf. also Wegenstein, *Cosmetic Gaze* and Abend and Fuchs, "Introduction."

that the self exercised on the self, such as meditation, examination of conscience, mental representations, or most prominently verbal confession. In modernity, according to M. Butler, economically driven work on the self for productive self-engineering was the most popular form of techniques of the self, while postmodernity is characterized by a playful interaction with notions of the self and identity. Abend and Fuchs argue that in the contemporary moment, techniques such as the Quantified Self merge all these aspects – care-taking, work, play – in their technologies, thus combining many of the previous "techniques of the self" (Abend and Fuchs 9). This is certainly also true for many other DIY techniques under consideration here.

Still, Abend and Fuchs see a transformation in the original concept of the techniques of the self, a shift from subject-centered techniques to use of digital technology, from introspection to continuous monitoring and feedback (Abend and Fuchs 12–13). With the somatization of the self, this shift, furthermore, is accompanied by a change from techniques of the self focusing on the inner world of an individual to techniques that pertain to the outside, a "shift away from the examination of the consciousness and soul towards the examination of the body" (Abend and Fuchs 12). Marcel Mauss described such techniques as "techniques of the body:" From an anthropological perspective, Mauss examines how (useful) everyday activities such as walking, running or sleeping are contextualized, learned and taught – how the body is adjusted to its purpose in a social setting. Mauss thereby emphasizes the intersection of the biological and social as a key feature in how bodies become a set of "techniques" (Thacker 56; Abend and Fuchs 12).

Risk, Vulnerability and Responsibility

As the discussion of Foucault and his disciples will have illustrated, contemporary molecular biopolitics takes on a new quality of uncertainty, (un)predictability, and vulnerability. Vulnerability, here, can be considered as an overarching concern – one that is also inherently related to new materialism – which is why I will first introduce its most relevant characteristics, before relating them to the discourses of risk, susceptibility and responsibility. Broadly two strands of conceptualizations in scholarship on vulnerability can be discerned: One approach sees vulnerability as the "ontological condition of our humanity:" "[t]o be vulnerable is to be fragile, to be susceptible to wounding and to suffering," a condition that is a shared feature of human embodiment. In this view, often, human life, the human body is vulnerable in itself but also in relation to others, dependent on their actions, care or support "to varying degrees at various points in our lives" (Mackenzie et al. 4-6). According to Judith Butler, for example, the human body is inherently vulnerable to the actions of others, with some parts of the population being more exposed, more precarious than others.[40] Other definitions of vulnerability focus more closely on the susceptibility of particular groups

40 cf. J. Butler *Precarious Life*. In their 2016 essay collection, *Vulnerability in Resistance*, J. Butler et al., moreover, look at the dichotomy between vulnerability and resistance, proposing strategies of resistance and subversion that also explicitly include questions of vulnerability and vulnerable populations.

or persons – "those with reduced capacity, power, or control to protect their interests relative to other agents" – "inequalities of power, dependency, capacity, or need" that leave them more vulnerable to harms, threats and exploitation by others (Mackenzie et al. 4-6). Combining these two conceptualizations, Mackenzie et al. suggest a taxonomy of vulnerability that distinguishes different sources and states of vulnerability, allowing us to acknowledge both the inherent vulnerability of the human condition and the identification of contexts and situations that leave different persons or groups of persons more vulnerable than others (7-9).[41] Also in the analysis and discussions in this book vulnerability as the inherent condition of human embodiment and the more context-specific forms of vulnerability will play a role: The former in relation to the discourse of risk, the desire to know more and to control the body to obliterate such feelings of vulnerability, the susceptibility to inside and outside forces, as well as the promises and fears that exacerbate its experience; the latter when we consider differently distributed access, power relations, capabilities, also on a global scale.

Much of this perceived vulnerability, we could argue, also stems from the discourses of risk so prevalent in contemporary life. Beginning in the 19th century, the body came to be charted, calculated, expressed through tables, norms and means that gave rise to the notion of life itself as calculable and thus as assessable in risks, probabilities, and likelihoods. The complex term "risk" originally had many different, rather neutral meanings, most prevalent among them the mathematical idea of expressing the likelihood that an event may occur. While risks as pure numerical data are still rather neutral – based on studies we *can* calculate the probability of events – what we do with these data in our processes of meaning making, our discourses, is a different thing. Risk has received negative associations, is connoted with danger also in public health discourses: being "at high risk" means being "in danger of," for example, developing a disease (Lupton, "Risk" 460-61). In the discourse of public health, risk is often conceptualized as either external – for example environmental factors over which an individual has little to no control – or as internal – as the consequence of lifestyle choices that individuals can (and should) control (Lupton, "Risk" 461-62).[42] It is this latter form of risk that

41 They differentiate different sources of vulnerability: *inherent* (the intrinsic vulnerability of the human condition), *situational* (context specific sources, potentially caused by different "personal, social, political, economic or environmental situations of individuals or social groups," short term, intermittent, or enduring), and *pathogenic* (created for example through "dysfunctional or abusive interpersonal and social relationships and sociopolitical oppression or injustice"). Inherent and situational vulnerability, moreover, can have different states: they can be dispositional or occurrent, potential vulnerabilities versus actually occurring ones. A quote from Mackenzie et al. will illustrate this distinction: "For example, all fertile women of childbearing age are dispositionally vulnerable to life-threatening complications in childbirth. But whether or not a pregnant woman is occurrently vulnerable to such complications will depend on a range of factors, both inherent and situational, such as her physical health, medical history, socioeconomic status, geographical location, access to health care, and cultural norms relating to pregnancy and childbirth. The dispositional–occurrent distinction serves to distinguish vulnerabilities that are not yet or not likely to become sources of harm from those that require immediate action to limit harm" (Mackenzie et al. 7-9).

42 One of the most famous evocations of such a "risk society" is that of sociologist Ulrich Beck. Beck looks at the risk society as a culture increasingly aware of its potential for destruction through

has gained a lot of cultural resonance in late-capitalist society: Here, the individual is seen as responsible for avoiding health risks for their own wellbeing but also the good of society (by, for example, preventing illness to lower health care expenditure) (Lupton, "Risk" 463). As such risk is also a constructed, normative discourse that aims at governing bodies and lifestyles. It is predominant in many of the contemporary discourses around health, for example when it comes to smoking, drug and pharmaceuticals abuse, physical fitness and obesity, overeating and diabetes, even heart disease. This risk discourse works through "calculations about probable futures" followed by "interventions into the present" (7) in order to control that future, a logics of prevention and preemption: Identifying those deemed at risk (individually and collectively) and then acting on them through observation, treatment, responsibilization and (self-)management (Rose, *Politics of Life* 7, 70-71, 107). Risks, it has been proclaimed, are to be avoided and reduced.[43]

When risk is communicated to individuals (and collectives, for that matter), for example through individual test results or in publications, risk factors are often framed as *susceptibilities* to certain diseases or conditions. An offspring of earlier theories of "predisposition" and inheritance, the molecularization of risk and biological information moved susceptibility from correlations of different factors – such as age, weight, and family history – to the molecular make-up of individual bodies (Rose, *Politics of Life* 18-20; 84-87). In order to describe the rise of genetic risk, or genetic susceptibility, one needs to look closer at how genes and disease are connected: In contrast to the expectation of the Human Genome Project (to find clear genetic causes for disease by offering a 'genetic roadmap' of sorts), its completion led to the realization that only a small number of human diseases are caused by a single gene (Huntington's disease being one of those mono-genetic diseases). Many more conditions are associated with changes in single nucleotide bases at different locations in the genome: Those Single Nucleotide Polymorphisms (SNPs) contribute to the risk of developing conditions like heart disease, diabetes, or cancer.[44] Their discovery and study, thus, contributed a great deal to the implementation of a logics of probability and susceptibility, by putting in numbers or relations the likelihood of developing a certain condition. This form of thinking along the lines of SNPs opens genetics up to the discourse of risk assessment, prediction and

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nuclear war, environmental and biological catastrophes (Tomes 625). According to Beck, risk is an intrinsic part of the experience of modernity, calculated in numbers and probabilities and known through science. He argues that the risk society focuses on the distribution of risk, not wealth, among the population. This distribution of risks inverses the distribution of wealth: wealth accumulates at the top, risk accumulates on the bottom – but in the risk society no one can fully escape risks anymore, even though the wealthy have more means to circumvent them (Lidskog).

43 This becomes problematic when we can no longer live with risks. "Risk literacy" is a skill-set used to set risks into context (also with each other) and, based on reliable data, make informed choices about the risks we are willing to take. For risk literacy in medical decision making, cf. Operskalski and Barbey.

44 Genetic tests, then, scan for such SNPs and calculate a numerical risk of contracting a disease, adding or subtracting the risks associated with single SNPs often on multiple loci on multiple chromosomes to form an overall overview. While the SNP itself does not have to be the culprit, it does indicate that something in the vicinity may lead to a risk not experienced by somebody who does not have that specific SNP.

management (cf. Rose, *Politics of Life* 18-20; 84-87). The "premonitory knowledges" (Lock) – knowledges that "bring potential futures into the vital present and make them calculable" – create obligations for the self to act in the present upon the self, one's body, one's health, one's choices with an eye to that potential future (Rose, "Genomic Susceptibility" 147).

This connection between screening and (early) intervention is an intrinsic part of the politics of life in the 21st century and seems to proliferate with the development of sophisticated testing, screening, and imaging technologies (Rose, *Politics of Life* 18–20; 84-87). Today, individuals can be tested for a growing number of single-gene disorders and also many SNP-based tests are available to determine the likelihood of developing a disorder and many of those tests are not just self-chosen but also self-administered in a DIY fashion.[45] Susceptibility, then, describes a certain vulnerability, a personalized form of risk. The "molecular politics of (genetic) risk" that Lemke formulates following Foucault's bio- and anatomo-politics transcends concerns with discipline and discrimination and aims at design, at configuring "healthy" human existence ("Disposition" 562). Lemke argues that the concept of information is crucial: "In the molecular genetic perspective, information at the same time serves as the 'code of life' and as the 'key to freedom'" (558). The assumption is that with sufficient information, risk management and lifestyle changes, illness can be avoided.[46] In Lemke's position, we can see how prudent decisions are possible only when individuals have enough medical and genetic knowledge about the self ("Disposition" 558–59). This connection between the possession of information and prudence in the face of ever-present risk (factors) also demonstrates how risk can become a critical factor in many self-directed interventions into the body, especially those who aim at a deeper knowledge of one's own biology.

Genetic governmentality, Lemke argues, creates a new individualized body politic, "which calls on us to be as economic as possible with our own body, health or 'quality of life'," but also gives rise to new forms of (collective) social identity, political activism, and "biosociality," to use Rabinow's term ("Disposition" 561). It creates new forms of vulnerability and new ways of assessing and defining the self in relation to its biology. Risk, thus, manifests in individual bodies and lives, but also in the assemblage of bodies and collectives.[47] The high prevalence of this form of risk thinking generates a sense that all persons "though existentially healthy are actually asymptomatically or pre-symptomatically ill" (Rose, *Politics of Life* 18-20; 84-87) and thus gives rise to new

45 Genetic and molecular tests as a type of DIY biology and medicine are analyzed in Chapter 8.

46 But risk and susceptibility are also concepts that are notoriously difficult to grasp and communicate, requiring a high degree of (biological) literacy on the part of an individual. This is true not just for biological risks, though they require more specialized biological knowledge, but also day to day risks and probabilities, such as the probability of winning the lottery or the risks associated with flying or other forms of transportation.

47 Another interesting means of conceptualizing bodies at risk in a globalized society is seeing them as being part of a global (molecular) economy of exchange and circulation, as being part of a molecular world filled with risks: of infection, contamination, and so forth. This type of risk is expressed in relation to global or transnational pandemics (such as bird flu, Ebola, the Zika Virus). Braun more closely looks at this understanding of the molecular body as displaced in wider molecular fields of risk (Braun 7).

subjectivities. Risk is increasingly treated "as if it were an illness in and of itself:" More screening and more monitoring of bodies and bodily functions leads to an increasing medicalization (Conrad, *Medicalization* 163) and creates new categories of individuals, "new individual and collective subjectifications of those 'at risk'" (Rose, *Politics of Life* 19). According to Rose, the person "genetically at risk" is born at the intersection of at least three trajectories in contemporary bio-medical practice and thought: the growing belief in society in a genetic basis of many conditions (both as mono-genetic diseases with clear causation and in the form of susceptibilities), the confidence and ability on the part of researchers to find genetic markers associated with a condition, and the claims of doctors to identify conditions through diagnostic tests (*Politics of Life* 106-07). The fear connected to the increasingly subjectification of people as "persons at risk" is that they will be treated differently in the work market, with regard to health insurance, or in their personal life, even though many contingencies remain and the outlook is only probabilistic (the penetrance of a gene may be unknown, time and severity of unset uncertain) (Rose, *Politics of Life* 70-71, 107). I would argue that it is also this fear of biological determinism, of being defined via one's genetic biology, that gives genetic testing an aura of certainty that it does not (yet) have. The "promise of certainty" attached to genetic testing is only illusory (Rose, "Politics" 11-12): Too many factors influence the actual development of the disorder, even in cases such as Huntington's – previously thought to be a certainty – where the length of the wrongfully added nucleotide sequence now is believed to have an impact on the time of onset and severity of the disorder. Genetic testing, then, opens another space of uncertainty populated by those "asymptomatically or presymptomatically ill," those who carry the markers but are not (yet) sick (Rose, "Politics" 11-12). Similarly, the choice to act or not act in response to knowledge about risks and susceptibilities is only illusory (Lupton, "Risk" 466). As responsible citizen, the somatic self is obliged to act or suffer the consequences of moral isolation, social stigma and sanctions.

Neoliberal governmentality needs and fosters subjects that understand that they are responsible for themselves and act accordingly.[48] In neoliberal democracies, thus, individuals are obligated to seek out information (about the self), take action, maximize their quality of life and life chances – to act responsibly towards themselves, others and society at large (Rose, *Politics of Life* 107–08). In public health discussions, the discourse of "at risk" allows us to judge and moralize the behavior of individuals, assigning guilt and responsibility: genetic explanations thus do not lead to responsibility being taken from the subject, but the subject rather gains a new "genetic responsibility" (Lemke, "Disposition" 558-59). This genetic responsibility does not just change how one should act prudently for oneself, but genetic illnesses are thought of in familial terms as affecting past, present and future families and thus create new obligations to one's partner, children, career or other financial obligations (Rose, *Politics of Life* 107-08). As we can see both in Rose and Lemke's account, health has become a moral responsibility and a personal duty, to oneself and others. This return of moralizing discourses, however,

48 For more on this see for example Mitchell Dean, *Governmentality: Power and Rule in Modern Society*, 1999.

happens stealthily, 'through the backdoor:' It is no longer bound on religious precepts but on scientific norms and a covertly disciplinary politics of life.

Biological and Scientific Citizenship

According to Rose, the subjectification of individuals under new forms of (self-)government of body and self, leads to a new form of "biological citizenship." He uses "biological citizenship" descriptively for all projects that "linked their conceptions of citizens to beliefs about the biological existence of human beings," as individuals, men, women, families, linkages, communities, populations, races, or species (*Politics of Life* 132-34; 140-41; 149; 223). Rose and Novas describe "biological citizenship" as both individualizing and collectivizing: Individuals relate to themselves with knowledge of their somatic individuality and concomitant responsibilities and are embedded into new forms of "biosociality" and collectivities around biomedical classifications, online and offline (Rose and Novas 441-42).[49] Similarly, Torsten Heinemann writes that biological citizenship acknowledges the role of new bio-social collectivities – such as patient advocacy or self-help groups – for new forms of public participation, patient empowerment, and involvement in political debates.[50]

Biological citizenship requires those invested in their biology to become political: It involves "individuals and groups claiming their rights and struggling in the micro politics of health and in the macro politics of health care systems for funding, for research, and for provision" (Rose, "Genomic Susceptibility" 147-48). The requirements of Western neoliberal democracies to be flexible, to pursue life-long learning, to be perpetually assessed, to be nudged to improve oneself by monitoring one's health and managing one's risks, means that active, responsible biological citizens engage in self-evaluation and continuous modulation (Rose, *Politics of Life* 154). Biological citizenship, therefore, follows an ethics of activity, "in which the maximization of lifestyle, potential, health, and quality of life has become almost obligatory," whereas those who do not comply, who do not "adopt an active, informed, positive, and prudent relation to the future" are negatively judged and sanctioned – not by formal, government-directed power but by peer-pressure and comparison (Rose, *Politics of Life* 24-25). Biological citizenship, thus,

49 Paul Rabinow's concept of "biosociality", suggests "the emergence of such new social communities around particular biological conditions" and describes a "shift from a socio-biological culture which is modeled on nature to the culturalization and engineering of nature itself" (Burri and Dumit , "Introduction" 5). For Rose and Novas the internet is crucial as a means of communication and information exchange – literacy is a key term here – and as a community-formation device. For them webpages and virtual communities perpetuate their ideal of active, biological citizenship in that they encourage people to become involved in communities of people that define themselves along biological, often molecular or genetic, lines and thus to become politically active in a new way (Rose and Novas 445-46; Rose, *Politics of Life* 145-46).

50 Influential examples of such bio-social collectivities are patient advocacy groups, such as the Michael J. Fox Foundation for Parkinson's Research. Like them, some of these foundations and advocacy groups also contribute to clinical research on the progression of diseases, patterns and clinical markers – providing their members with new possibilities to contribute to the research of their diseases and in a second step to the clinical testing and development of new medications.

does not only consist of political claims to rights and provisions, but also includes a specific form of care for the self (Rose, "Genomic Susceptibility" 147-48).

This form of biological citizenship is linked to what Rose terms "scientific citizenship." Today, the sweeping advances in scientific and technological progress have led to the increasing need to educate citizens so that they can engage in informed debates over the resulting complex ethical and democratic dilemmas. Fostering the "public understanding of science" for Rose and Novas has two core functions: For one, it is a means to both address and compensate the "democratic deficit" said to exist when citizens are not active participants in the formation of scientific and technological futures. Moreover, a better understanding of science can also help to regain the trust and confidence of lay persons in the regulatory mechanisms of science (Rose, *Politics of Life* 140-42; Rose and Novas 445-446). It is this mindset that builds the foundation for arguments for "science education for citizenship" (Kolstø). Scientific literacy, here, is seen as a skill that all responsible citizens should have. The result of this entanglement of scientific education and decision-making process is a new form of scientific citizenship.

"Scientific citizenship," then, requires individuals to take an active role in enhancing their own scientific and biomedical literacy, to actively and dynamically search out knowledge – a process made comparatively easy through the internet as a powerful way to access information and exchange ideas (Rose, *Politics of Life* 140-42). Scientific literacy and citizenship go hand in hand: People need to be educated about biotechnologies and their implications in order to make decisions about their value and use. They need to be educated about positive and negative impacts of technologies to counter mistrust and foster open communication. This type of scientific literacy, however, is often not facilitated. Rather, contemporary biopolitical strategies create an obligation and compulsion to self-educate: responsible choices can only be made on the basis of knowledge. It is this form of active biological and scientific citizenship that is required and espoused by the "techniques of the self" under investigation in this book . DIY biology and medicine requires a high level of citizen engagement in science, scientific literacy, and a self-directed curiosity about the biological basis of life. Its techniques subject their users to this new form of self-management. DIY biology and medicine is political, exactly because it is based, to a large degree, on the older structures of risk assignment, population management, responsibilization and citizenship described in this subchapter.

2.4 Coda: Why Representation Still Matters

Because they are embedded in diverse trajectories and politico-economic logics, the "politics of hacking life" are complex and multifaceted (Meyer, "Hacking"). To gauge them in their full complexity, many of the tools and theoretical resources developed in this chapter will surface again and again in this book . As I have shown in the discussions above, different approaches to the body and embodiment create new points of view and new conceptualizations, but also new problems. They bring with them both advantages and disadvantages. Both constructivist and materialist approaches fail in one way or the other in their pursuit to adequately theorize and capture the lived real-

ity of bodies. Constructivist and poststructuralist approaches risk denying the material reality of life, of embodiment – such as the material reality of pain felt in and through a body. They cannot fully address what is at stake in contemporary biopolitics, especially when it comes to the material transformations of bodies through capitalism and power relations (Pitts-Taylor, "Mattering" 7). At the same time, however, materialist approaches risk denying the importance of culture for how bodies are lived, experienced and shaped. By failing to include representation into their discussions, they deny its material effects on bodies: how they shift and change in response to representations, how individuals decide to transform their bodies according to their preferred symbolic meaning.

The question that arises, then, is how to reconciliate the insights of constructionism with the need to attend to matter, the body, materialism, ontology? In order to redress the shortcomings of these lines of thought in isolation, newer approaches try their hand at a combination of materiality and governmentality, of materiality and symbolic representation, of ontology and epistemology. Disability studies seems to be a promising beginning for this exploration: While disability theorists have always insisted on the socially constructed nature of disability, they asserted its material reality as well.[51] Tobin Siebers, for example, tries to capture this contradictory experience in his notion of *complex embodiment*. Siebers uses this term to describe the experience of having a "material-semiotic body," a body that is material but also symbolically shaped. This theory sees the body and representation as mutually transformative: "Social representations obviously affect the experience of the body…but the body possesses the ability to determine its social representation as well" (25-26). Donna Haraway uses the idea of the "materialist-semiotic" to combine bodily materiality with the discursive-linguistic to obliterate the divide between nature and culture ("Situated Knowledges"). More recently, Victoria Pitts-Taylor applies such a material-semiotic, an ontologist and epistemologist, view in her discussion of the plastic brain in order to understand the "making and meaning" of bodies, "without denying them realness" (*Brain's*, 1). Such approaches are useful in a cultural study of bodies because they stress the need to include representations into considerations of the body: Representations can contribute a great deal to how people experience and value their bodies, how they want to transform them, what meanings they read into them.

In such materialist-semiotic approaches, we encounter the body as indeed being formed by two highly intertwined entities: one semiotic body, one material or physical one, with the latter being turned into the former in and through representation. This abstraction is a conscious choice – as we know signs are never completely equivalent to their signifier – about what is represented. The semiotic body of representation, thus, will only ever capture parts of the lived reality of the material one, while the material one, in turn, is shaped by the abstractions and simplifications inherent in the

51 Many theorists in disability studies argue that bodies are 'disabled' through culture, society and their environments, for example when buildings are not designed as or converted to be accessible: It is not necessarily the body that is 'disabled' but the lack of a ramp instead of a staircase that 'disables' the body. At the same time, they do not want to negate the lived experience and reality of pain and physical limitations.

semiotic process. To give a more practical example, human fantasies of perfection in science fiction focus in their representations on the positive sides of enhancements – the promise of superiority, of infallibility, of physical extension and (in some cases) immortality – while they often choose to ignore the negative sides, the pain, the trauma, the isolation that potentially comes with material transformation. What we see, thus, is, again, a utopian vision. But it is this utopian vision that, to follow Wegenstein, in a circular gaze shapes the expectations and experience of the material bodies in front of the screen (*Cosmetic Gaze* 2).[52] This is also how representation, the imaginary sphere of biology, still 'matters' in the most literal sense.[53]

In the contemporary DIY techniques and technologies, the body is not (only) seen as a social construction, but indeed as a material reality, an assemblage of pieces. The engagement in social and ideological contests over the body, its meaning and significance, makes them decisively political. They are part of the new politics of life, new forms of individual and collective subjectification in which our "biology" is "highly salient to practices of identity formation" (Rose, "Race, Risk" 430). However, while identities can be constructed in and through DIY techniques, the body is the tool to work with and at the same time the material to be worked on. In DIY techniques, nature and culture intersect and are of equal importance. In my analyses, therefore, I choose a combined approach via representation and its material effects on bodies. Representations, visual and linguistic ones, are understood as evoking and transmitting affects between and beyond bodies. These affects materialize in bodies, determining how individuals experience, live in and judge their bodies, take action to reform and shape them.[54] What results is a "corporeal politics of plasticity" (Pitts-Taylor, *Brain's* 6), in which the body is seen as open, amenable to, even inviting transformation – a politics in which transformation is indeed a cultural requirement. This is also an effect of the insertion of affective life into neoliberal pursuits of re-shifting market relations to "life itself," here in the form of subsuming more aspects of daily life into the dictate of the market, for example by creating bodies that conform to ideals of fitness or heralding self-optimization in the name of the market.[55] In DIY technologies, therefore, we find complex entanglements of representation, power, capital and identity with the material body.

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52 Social Media, especially visual media like *Instagram*, can be considered as an even more up-to-date medium through which such a circular gaze is created. In connection to disease, an overarching question resulting from this preoccupation with utopian visions of the body is whether or not some co-morbidities of disease states (e.g., depression) might be linked to the social- and emotional pressure to conform to desired body images.

53 This duality of meaning is definitively intended: Representation is still important – despite a lack of engagement with the sphere of the representational in new materialism – but representation also has a high influence on 'matter.'

54 Latham and Derek P. McCormack, for example, argue that representations function affectively (*Thinking with Images*, 2009). Similarly, Ben Anderson claims that a focus on materiality does not exclude representation when he writes: "Attention to affect does not preclude an attention to representation and affect is not somehow the non-representational 'object' per se. Instead, we must pay attention to how representations function affectively and how affective life is imbued with representations." (*Encountering Affect* 13-14).

55 Broadly following Anthony Negri's writings on the „real subsumption of life" Ben Anderson argues that in "real subsumption of life" desires, subjectivities, and needs mutate with capital circulation

How do the politics of life created by DIY biology materialize in bodies and corporeal processes? (Popular) culture offers ample examples of how individual bodies and our experience of and with (our) biology are transformed through DIY practices. From these we can infer the underlying values and assumptions about what it means to be biological, to be human, to have a body, about what is accepted and what is policed. Acknowledging the inextricable entanglement of biological and socio-cultural thinking means that we need to make sure that these transformations in how we see and conceptualize ourselves as biological beings prevent rather than exacerbate social injustices, discrimination and social stratification (cf. Rose, "Race, Risk" 436).

and that all aspect of human life become a source of value, pointing towards a systematic relation between capital and life ("Affect and Biopower" 33).